The Book of Rentz

FFG-46 (as built)

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Introduction

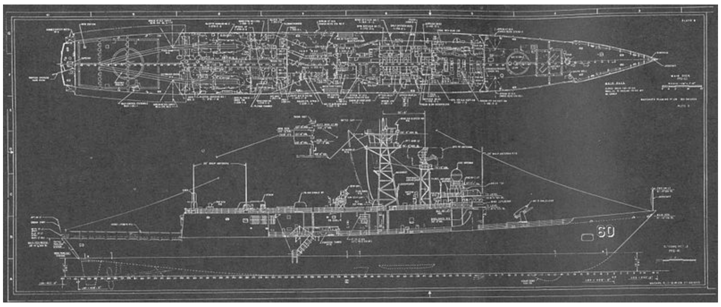
Oliver Hazard Perry class frigate

USS *Oliver Hazard Perry* (FFG 7) underway in the Great Lakes	
Class overview	
Name:	Oliver Hazard Perry
Builders:	Bath Iron Works Todd Pacific Shipyards San Pedro Todd Pacific Shipyards Seattle Australian Marine Engineering Consolidated Bazan China Shipbuilding
Operators:	United States Navy Royal Australian Navy Armada Española Republic of China Navy Pakistan Navy Royal Bahrain Naval Force Egyptian Navy Polish Navy Turkish Navy
Preceded by:	*Brooke*-class frigate
Subclasses:	*Adelaide*-class (Australia) *Santa María*-class (Spain) *Cheng Kung*-class (Republic of China)
Built:	1975 – 2004
In commission:	1977 – Present
Completed:	71
General characteristics	
Type:	Frigate
Displacement:	4100 long tons (4200 t) full load
Length:	408 ft (124 m) waterline, 445 ft (136 m) overall, 453 ft (138 m) for "long-hull" frigates
Beam:	45 ft (14 m)
Draft:	22 ft (6.7 m)
Propulsion:	2 × General Electric LM2500-30 gas turbines generating 41000 shp (31000 kW) through a single shaft and variable pitch propeller 2 × Auxiliary Propulsion Units, 350 hp (260 kW) retractable electric azipods for maneuvering and docking.
Speed:	over 29 knots (54 km/h)
Range:	4500 nmi (8300 km; 5200 mi) at 20 knots (37 km/h; 23 mph)
Complement:	176

Sensors and processing systems:	**Radar:** AN/SPS-49, AN/SPS-55, Mk 92 fire control system **Sonar:** SQS-56, SQR-19 Towed Array
Electronic warfare and decoys:	SLQ-32(V)2, Flight III with sidekick, Mark 36 SRBOC AN/SLQ-25 Nixie
Armament:	One single-arm Mk 13 Missile Launcher with a 40-missile magazine that contains SM-1MR anti-aircraft guided missiles and Harpoon anti-ship missiles. Removed from the U.S. Navy ships starting in 2003, due to the retirement of the SM-1 missile from American service Two triple Mark 32 Anti-submarine warfare torpedo tubes with Mark 46 or Mark 50 anti-submarine warfare torpedoes One OTO Melara 76 mm/62 caliber naval gun One 20 mm Phalanx CIWS rapid-fire cannon Eight Hsiung Feng II SSM or four HF-2 and 4 HF-3 supersonic AShM, plus 2 Bofors 40mm/L70 guns on Taiwanese vessels only)
Aircraft carried:	Two LAMPS multi-purpose helicopters (the SH-2 *Seasprite* LAMPS I on the short-hulled ships or the SH-60 *Seahawk* LAMPS III on the long-hulled ships)

The ***Oliver Hazard Perry* class** is a class of frigates named after the American Commodore Oliver Hazard Perry, the hero of the naval Battle of Lake Erie. Also known as the Perry or FFG-7 class, the warships were designed in the United States in the mid-1970s as general-purpose escort vessels inexpensive enough to be bought in large quantities to replace World War II-era destroyers. They operated in an anti-submarine role to protect amphibious landing forces, supply and replenishment groups, and merchant convoys.[1] Fifty-five ships were built in the United States: 51 for the United States Navy and four for the Royal Australian Navy (RAN). In addition, eight were built in the Republic of China (Taiwan), six in Spain, and two in Australia for their navies. Former U.S. Navy warships of this class have been sold or donated to the navies of Bahrain, Egypt, Poland, Pakistan, and Turkey.

Design and construction


Blueprint of "long-hull" design USS *Rodney M. Davis* (FFG-60).

The ships were designed by the Bath Iron Works shipyard in Maine in partnership with the New York-based naval architects Gibbs & Cox.

The *Oliver Hazard Perry*-class ships were produced in 445-foot (136 meter) long "short-hull" (Flight I) and 453-foot (138 meter) long "long-hull" (Flight III) variants. The long-hull ships (FFG 8, 28, 29, 32, 33, and 36-61) carry the larger SH-60 *Seahawk* LAMPS III helicopters, while the short-hulled warships carry the smaller and less-capable SH-2 *Seasprite* LAMPS I. Aside from the lengths of their hulls, the principal difference between the versions is the location of the aft capstan: on long-hull ships, it sits a step below the level of the flight deck in order to provide clearance for the tail rotor of the longer *Seahawk* helicopters. The long-hull ships also carry the RAST (Recovery Assist Securing and Traversing) system for the *Seahawk*, a hook, cable, and winch system that can reel in a *Seahawk* from a hovering flight, expanding the ship's pitch-and-roll range in which flight operations are permitted. The FFG 8, 29, 32, and 33 were built as "short-hull" warships but were later modified into "long-hull" warships.

American shipyards constructed *Oliver Hazard Perry*-class ships for the U.S. Navy and the Royal Australian Navy (RAN). Early American-built Australian ships were originally built as the "short-hull" version, but they were modified during the 1980s to the "long-hull" design. Shipyards in Australia, Spain, and the Republic of China have produced several warships of the "long-hull" design for their navies.

Although the per-ship costs rose greatly over the period of production, all 51 ships planned for the U.S. Navy were built. Some *Oliver Hazard Perry*-class warships are planned to remain in American service for years, but some of the older ships have been decommissioned and some scrapped. Others of these decommissioned ships have been transferred to the navies of other countries, including Bahrain, Egypt, Poland, Pakistan, and Turkey. Several of these have replaced old Second World War-built American destroyers that had been given to those countries.

During the design phase of the *Oliver Hazard Perry* class, head of the Royal Corps of Naval Constructors, R.J. Daniels, was invited by an old friend, US Chief of the Bureau of Ships, Adm Robert C Gooding, to advise upon the use of variable-pitch propellers in the class. During the course of this conversation, Daniels warned Gooding against the use of aluminium in the superstructure of the FFG-7 class as he believed it would lead to structural weaknesses. A number of ships subsequently developed structural cracks, including a 40 ft fissure in USS Duncan, before the problems were remedied.[2]

The *Oliver Hazard Perry*-class frigates were designed primarily as anti-aircraft and anti-submarine warfare guided-missile warships intended to provide open-ocean escort of amphibious warfare ships and merchant ship convoys in moderate threat environments in a potential war with the Soviet Union and the Warsaw Pact countries. They could also provide air defense against 1970s- and 1980s-era aircraft and anti-ship missiles. These warships are equipped to escort and protect aircraft carrier battle groups, amphibious landing groups, underway replenishment groups, and merchant ship convoys. They can conduct independent operations to perform such tasks as surveillance of illegal drug smugglers, maritime interception operations, and exercises with other nations.

The addition of the Naval Tactical Display System, LAMPS helicopters, and the Tactical Towed Array System (TACTAS) gave these warships a combat capability far beyond the original expectations. They are well-suited for the littoral regions and most war-at-sea scenarios.

Notable combat actions

USS *Stark* listing to port following an air attack

Oliver Hazard Perry-class frigates made worldwide news twice during the 1980s. Despite being small, these frigates were shown to be extremely durable. During the Iran–Iraq War, on 17 May 1987, the USS *Stark* was attacked by an Iraqi warplane. Struck by two Exocet anti-ship missiles, thirty-seven American sailors died in the deadly prelude to the American Operation Earnest Will, the reflagging and escorting of oil tankers through the Persian Gulf and the Straits of Hormuz. Less than a year later, on 14 April 1988, the *Samuel B. Roberts* was nearly sunk by an Iranian mine. No lives were lost, but 10 sailors were evacuated from the warship for medical treatment. The U.S. Navy retaliated four days later with Operation Praying Mantis, a one-day attack on Iranian oil platforms being used as bases for raids on merchant shipping. Those had included bases for the minelaying operations that damaged the *Samuel B. Roberts*. Both frigates were repaired in American shipyards and returned to full service. The USS *Stark* was decommissioned in 1999, and scrapped in 2006.

Modifications

United States

The U.S. Navy is modifying its remaining *Perrys* to reduce their operating costs, replacing Detroit Diesel Company electrical generators with Caterpillar, Inc.-made diesel engines.

In mid-2000, the Navy removed the frigates' Mk 13 single-arm missile launchers and magazines because the primary missile, the Standard SM-1MR, became outmoded.[3]

The "zone-defense" anti-aircraft warfare (AAW) capability has vanished, and all that remains is a "point-defense" type of AAW armament. It would supposedly have been too costly to refit the Standard Missile SM-1MR missiles, which had little ability to bring down sea-skimming missiles. Another reason is to allow more SM-1MRs to go to American allies that operate *Perrys*, such as Poland, Spain, Australia, Turkey, and the Republic of China (Taiwan).

The loss of the launchers also strips the frigates of their Harpoon anti-ship missiles. However, their *Seahawk* helicopters can carry the much shorter-range Penguin anti-ship missile.

USS *Rodney M. Davis* (FFG-60) after the removal of her foredeck Mk 13 missile launcher.

The last nine ships of the class will have new remotely operated 25-mm Mk 38 Mod 2 Naval Gun Systems installed on platforms over the old MK 13 launcher magazine.

The U.S. Navy plans to update the *Oliver Hazard Perry*-class warships' Phalanx CIWS to the "Block 1B" capability, which will allow the Mk 15 20 mm Phalanx gun to shoot at fast-moving surface craft and helicopters. The remaining *Oliver Hazard Perry*-class ships are also to be fitted with the Mk 53 DLS "Nulka" missile decoy system, which will be better than the presently-equipped chaff (SRBOC, Super Rapid Blooming Offboard Chaff) and flares at guarding against anti-ship missiles.

On June 16, 2009, Vice Adm. Barry McCullough turned down the suggestion of Rep. Mel Martinez to keep the *Perrys* in service, citing their worn-out and maxed-out condition.[4] However, Reps. Ander Crenshaw and Gene Taylor have taken up the cause.[5]

Australia

Australia is spending one billion Australian dollars to upgrade Royal Australian Navy (RAN) *Adelaide*-class guided-missile frigates, including equipping them to fire the SM-2 version of the Standard missile, adding an eight-cell Mk-41 [6] vertical launch system for Evolved Sea Sparrow missiles, and installing better air-search radars and long-range sonar.

The first of the upgraded frigates, HMAS *Sydney*, returned to the RAN fleet in 2005. Each of the four frigates to be upgraded have the work at the Garden Island shipyard in Sydney, Australia, with the modernizations lasting between 18 months and two years. These frigates are planned to be replaced starting in 2013 by three new *Hobart*-class air warfare destroyers equipped with the AEGIS combat system. However, the third of those destroyers will not be commissioned until 2017, at the earliest.

The cost will be partly offset, in the short run, by the decommissioning and disposal of the two older frigates. HMAS *Canberra* was decommissioned on 12 November 2005 at naval base HMAS *Stirling* in Western Australia and HMAS *Adelaide* was decommissioned at that same naval base on 20 January 2008.

Turkey

The Turkish Navy has commenced the modernization of its G class frigates with the GENESIS (Gemi Entegre Savaş İdare Sistemi) combat management system.[6] The first GENESIS upgraded ship was delivered in 2007, and the last delivery is scheduled for 2011.[7] The "short-hull" *Oliver Hazard Perry*-class frigates that are currently part of the Turkish Navy were modified with the ASIST landing platform system at the Gölcük Naval Shipyard, so that they can accommodate the S-70B *Seahawk* helicopters. Turkey is planning to add one eight-cell Mk 41 Vertical Launching Systems (VLS) for the Evolved Sea Sparrow missile, to be installed forward of the present Mk 13 missile launchers, similar to the case in the modernization program of the Australian Adelaide class frigates.[8] [9] [10] There are also plans for new components to be installed that are being developed for the Milgem class warships (*Ada class* corvettes and *F-100 class* frigates) of the Turkish Navy. These include modern Three-dimensional and X-band radars developed by Aselsan and Turkish-made hull-mounted sonars. One of the G class frigates will also be used as a test-bed for Turkey's 4,500-ton TF-2000 class anti-aircraft warfare (AAW) frigates that are currently being designed by the Turkish Naval Institute.

F-490 TCG *Gaziantep* is a G class frigate of the Turkish Navy

Operators

- Australia (*Adelaide* class): The Royal Australian Navy purchased six frigates. Four of them were built in the United States while the other two were built in Australia. They are being upgraded since 2005, with the addition of an eight-cell Mk 41 VLS with 32 Evolved Sea Sparrow (ESSM) missiles, and the Standard Missile SM-2, plus upgraded radars and sonars.
- Bahrain: The USS *Jack Williams*, a gift of the American government in 1996, and re-christened *Sabha*.
- Egypt (*Mubarak* class frigates): Four *Oliver Hazard Perry*-class frigates were transferred from the U.S. Navy.
- Pakistan: Six to be transferred,[11] FFG-8 McInerney transferred to Pakistani Navy in August, 2010.[12]
- Poland: Two frigates were transferred from the U.S. Navy in 2002 and 2003.
- Republic of China (*Cheng Kung* class): Taiwanese-built. Eight ships equipped with eight Hsiung Feng II anti-ship missiles, PFG-1101 and PFG-1105 now carrying four HF-2 and four HF-3 supersonic AShM. The rest of the ships in the class will change the anti-ship mix upon their major overhaul. Seven out of eight ships added Bofors 40 mm/L70 guns for both surface and anti-air use. On August 5, 2010 Taipei's *Apple Daily* newspaper reported that the U.S. government will sell Taiwan, for US$40 million, two additional Perry-class frigates that are about to be retired from the U.S. Navy.[13]
- Spain (*Santa Maria* class): Spanish-built: six frigates.
- Turkey (*G* class): Eight former U.S. Navy *Oliver Hazard Perry*-class frigates have been transferred to the Turkish Navy. All eight are undergoing extensive modernization, and they are now know as the *G Class* frigates. The Turkish Navy modernized *G Class* frigates have an additional Mk-41 Vertical Launch System capable of launching Evolved Sea Sparrow missiles for close-in, as well as their longer-range SM-1 missiles; advanced digital fire control systems and new Turkish-made sonars.
- United States: The U.S. Navy commissioned 51 FFG-7 class frigates between 1977 and 1989. As of early 2011, 28 long-hull *Oliver Hazard Perry*-class frigates remain in active service.

On May 11, 2009, the first International Frigate Working Group met in Mayport Naval Station to discuss maintenance, obsolescence and logistics issues regarding Oliver Hazard Perry-class ships of the U.S. and foreign navies.[14]

The *Oliver Hazard Perry* frigates

Ship Name	Hull No.	Builder	Commission–Decommission	Fate	Link
U.S.-built					
Oliver Hazard Perry	FFG-7	Bath Iron Works	1977–1997	Disposed of by scrapping, dismantling, 21 April 2006	[16]
McInerney	FFG-8	Bath Iron Works	1979–2010	Transferred to Pakistan as PNS Alamgir (F-260)	[17]
Wadsworth	FFG-9	Todd Pacific Shipyards (Todd), San Pedro	1978–2002	Transferred to Poland as ORP *Gen. T. Kos'ciuszko* (273)	[18]
Duncan	FFG-10	Todd, Seattle	1980–1994	Transferred to Turkey as a spare-parts hulk	[19]
Clark	FFG-11	Bath Iron Works	1980–2000	Transferred to Poland as ORP *Gen. K. Pulaski* (272)	[20]
George Philip	FFG-12	Todd, San Pedro	1980–2003	Stricken, to be disposed of, 24 May 2004.	[21]
Samuel Eliot Morison	FFG-13	Bath Iron Works	1980–2002	Transferred to Turkey as TCG *Gokova* (F 496)	[22]
Sides	FFG-14	Todd, San Pedro	1981–2003	Stricken, to be disposed of, 24 May 2004.	[23]
Estocin	FFG-15	Bath Iron Works	1981–2003	transferred to Turkey as TCG *Goksu* (F 497)	[24]
Clifton Sprague	FFG-16	Bath Iron Works	1981–1995	transferred to Turkey as TCG *Gaziantep* (F 490)	[25]
built for Australia as HMAS *Adelaide*	FFG-17	Todd, Seattle	1980–2008	Decommissioned, to be sunk as diving & fishing reef	[26]
built for Australia as HMAS *Canberra*	FFG-18	Todd, Seattle	1981–2005	Decommissioned, sunk as diving & fishing reef, October 2009	[27]
John A. Moore	FFG-19	Todd, San Pedro	1981–2001	transferred to Turkey as TCG *Gediz* (F 495)	[28]
Antrim	FFG-20	Todd, Seattle	1981–1996	transferred to Turkey as TCG *Giresun* (F 491)	[29]
Flatley	FFG-21	Bath Iron Works	1981–1996	transferred to Turkey as TCG *Gemlik* (F 492))	[30]
Fahrion	FFG-22	Todd, Seattle	1982–1998	transferred to Egypt as *Sharm El-Sheik* (F 901)	[31]
Lewis B. Puller	FFG-23	Todd, San Pedro	1982–1998	transferred to Egypt as *Toushka* (F 906)	[32]
Jack Williams	FFG-24	Bath Iron Works	1981–1996	transferred to Bahrain as *Sabha* (90)	[33]
Copeland	FFG-25	Todd, San Pedro	1982–1996	transferred to Egypt as *Mubarak* (F 911)	[34]
Gallery	FFG-26	Bath Iron Works	1981–1996	transferred to Egypt as *Taba* (F 916)	[35]

Mahlon S. Tisdale	FFG-27	Todd, San Pedro	1982–1996	transferred to Turkey as TCG Gokceada (F 494)	[36]
Boone	FFG-28	Todd, Seattle	1982-	Naval Reserve Force, Active since 1998	[37]
Stephen W. Groves	FFG-29	Bath Iron Works	1982-	Naval Reserve Force, Active since 1997	[38]
Reid	FFG-30	Todd, San Pedro	1983–1998	transferred to Turkey as TCG *Gelibolu* (F 493)	[39]
Stark	FFG-31	Todd, Seattle	1982–1999	Disposed of by scrapping, dismantling, 21 June 2006	[40]
John L. Hall	FFG-32	Bath Iron Works	1982-	in active service, as of 2011	[41]
Jarrett	FFG-33	Todd, San Pedro	1983-	in active service, as of 2011	[42]
Aubrey Fitch	FFG-34	Bath Iron Works	1982–1997	Disposed of by scrapping, dismantling, 19 May 2005	[43]
built for Australia as HMAS *Sydney*	FFG-35	Todd, Seattle	1983-	in active service, as of 2011	[44]
Underwood	FFG-36	Bath Iron Works	1983-	in active service, as of 2011	[45]
Crommelin	FFG-37	Todd, Seattle	1983-	Naval Reserve Force, Active since 2003	[46]
Curts	FFG-38	Todd, San Pedro	1983-	Naval Reserve Force, Active since 1998	[47]
Doyle	FFG-39	Bath Iron Works	1983-	Naval Reserve Force, Active since 2002	[48]
Halyburton	FFG-40	Todd, Seattle	1983-	in active service, as of 2011	[49]
McClusky	FFG-41	Todd, San Pedro	1983-	Naval Reserve Force, Active since 2002	[50]
Klakring	FFG-42	Bath Iron Works	1983-	Naval Reserve Force, Active since 2002	[51]
Thach	FFG-43	Todd, San Pedro	1984-	in active service, as of 2011	[52]
built for Australia as HMAS *Darwin*	FFG-44	Todd, Seattle	1984-	in active service, as of 2011	[52]
De Wert	FFG-45	Bath Iron Works	1983-	in active service, as of 2011	[53]
Rentz	FFG-46	Todd, San Pedro	1984-	in active service, as of 2011	[54]
Nicholas	FFG-47	Bath Iron Works	1984-	in active service, as of 2011	[55]
Vandegrift	FFG-48	Todd, Seattle	1984-	in active service, as of 2011	[56]
Robert G. Bradley	FFG-49	Bath Iron Works	1984-	in active service, as of 2011	[57]
Taylor	FFG-50	Bath Iron Works	1984-	in active service, as of 2011	[58]
Gary	FFG-51	Todd, San Pedro	1984-	in active service, as of 2011	[59]
Carr	FFG-52	Todd, Seattle	1985-	in active service, as of 2011	[60]
Hawes	FFG-53	Bath Iron Works	1985–2010	Decommissioned, to be cannibalised in Philadelphia	[61]

Ford	FFG-54	Todd, San Pedro	1985-	in active service, as of 2011	[62]
Elrod	FFG-55	Bath Iron Works	1985-	in active service, as of 2011	[63]
Simpson	FFG-56	Bath Iron Works	1985-	Naval Reserve Force, Active since 2002	[64]
Reuben James	FFG-57	Todd, San Pedro	1986-	in active service, as of 2011	[65]
Samuel B. Roberts	FFG-58	Bath Iron Works	1986-	in active service, as of 2011	[66]
Kauffman	FFG-59	Bath Iron Works	1987-	in active service, as of 2011	[67]
Rodney M. Davis	FFG-60	Todd, San Pedro	1987-	Naval Reserve Force, Active since 2002	[68]
Ingraham	FFG-61	Todd, San Pedro	1989-	in active service, as of 2011	[69]
Australian-built					
HMAS *Melbourne*	FFG 05	Australian Marine Engineering Consolidated (AMECON), Williamstown, Victoria	1992-	in active service, as of 2011	
HMAS *Newcastle*	FFG 06	AMECON, Williamstown	1993-	in active service, as of 2011	
Spanish-built					
SPS *Santa María*	F81	Bazan, Ferrol	1986-	in active service, as of 2011	
SPS *Victoria*	F82	Bazan, Ferrol	1987-	in active service, as of 2011	
SPS *Numancia*	F83	Bazan, Ferrol	1989-	in active service, as of 2011	
SPS *Reina Sofía*	F84	Bazan, Ferrol	1990-	in active service, as of 2011	
SPS *Navarra*	F85	Bazan, Ferrol	1994-	in active service, as of 2011	
SPS *Canarias*	F86	Bazan, Ferrol	1994-	in active service, as of 2011	
Republic of China-built (Taiwanese)					
ROCS *Cheng Kung*	FFG-1101	China Shipbuilding, Kaohsiung, Taiwan	1993-	in active service, as of 2011	
ROCS *Cheng Ho*	FFG-1103	China Shipbuilding, Kaohsiung, Taiwan	1994-	in active service, as of 2011	
ROCS *Chi Kuang*	FFG-1105	China Shipbuilding, Kaohsiung, Taiwan	1995-	in active service, as of 2011	
ROCS *Yueh Fei*	FFG-1106	China Shipbuilding, Kaohsiung, Taiwan	1996-	in active service, as of 2011	
ROCS *Tzu I*	FFG-1107	China Shipbuilding, Kaohsiung, Taiwan	1997-	in active service, as of 2011	
ROCS *Pan Chao*	FFG-1108	China Shipbuilding, Kaohsiung, Taiwan	1997-	in active service, as of 2011	
ROCS *Chang Chien*	FFG-1109	China Shipbuilding, Kaohsiung, Taiwan	1998-	in active service, as of 2011	
ROCS *Tian Dan*	FFG-1110	China Shipbuilding, Kaohsiung, Taiwan	2004-	in active service, as of 2011	

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Oliver Hazard Perry

Oliver Hazard Perry	
August 23, 1785 – August 23, 1819 (aged 34)	
The Hero of Lake Erie	
Place of birth	South Kingstown, Rhode Island
Place of death	Trinidad
Place of burial	Newport, Rhode Island
Allegiance	United States of America
Service/branch	United States Navy
Years of service	1799-1819
Rank	Commodore
Commands held	USS *Nautilus* USS Revenge U.S. Naval Forces, Lake Erie -USS *Lawrence* -USS *Niagara* USS *Nonsuch*
Battles/wars	Quasi-War with France Haitian Revolution First Barbary War - Battle of Derna War of 1812 -Battle of Lake Erie

Commodore **Oliver Hazard Perry** (August 23, 1785 – August 23, 1819) was born in South Kingstown, Rhode Island, the son of Captain Christopher Raymond Perry and Sarah Wallace Alexander, a direct descendant of William Wallace.[1] He was an older brother to Commodore Matthew Calbraith Perry who compelled the opening of Japan to the West by threat of force. He served in the War of 1812 against Britain, and at the age of 27 earned the title "Hero of Lake Erie" for leading American forces in a decisive naval victory at the Battle of Lake Erie.[1]

Biography

As a boy, Perry lived in Rhode Island, sailing ships in anticipation of his future career as an officer in the US Navy. He was educated in Newport, Rhode Island, and was appointed a midshipman in the United States Navy on April 7, 1799. During the Quasi-War with France, he was assigned to his father's frigate, the USS *General Greene*. He first experienced combat on February 9, 1800, off the coast of the French colony of Haiti, which was in a state of rebellion.[2]

During the First Barbary War, he served on the USS *Adams* and later commanded the USS *Nautilus* during the capture of Derna. Beginning in 1806, he commanded the sloop USS *Revenge*, engaging in patrol duties to enforce the Embargo Act, as well as a successful raid to regain a U.S. ship held in Spanish territory in Florida. On January 9, 1811, the *Revenge* ran aground off Rhode Island and was lost. The following court-martial exonerated Perry, placing blame on the ship's pilot .[3] In January 2011, a team of divers claimed to have discovered the remains of the *Revenge*, nearly 200 years to the day after it sank.[4] [5]

Following the court-martial, Perry was given a leave of absence from the navy. On May 5, 1811, he married Elizabeth Champlin Mason, whom he had met at a dance in 1807,[3] and enjoyed an extended honeymoon touring

New England. The couple would eventually have five children, with one dying in infancy.[6]

Hero of Lake Erie

At his request he was given command of United States naval forces on Lake Erie during the War of 1812. U.S. Secretary of the Navy Paul Hamilton had charged prominent merchant seaman Daniel Dobbins with building the American fleet on Presque Isle Bay near Erie, Pennsylvania, and Perry was named chief naval officer.

On September 10, 1813, Perry's command fought a successful fleet action against a task force of the Royal Navy in the Battle of Lake Erie. It was at the outset of this battle that Perry famously said, “If a victory is to be gained, I will gain it.”[7] Initially, the exchange of gunfire favored the British. Perry's flagship, the USS *Lawrence*, was so severely disabled in the encounter that the British commander, Robert Heriot Barclay, thought that Perry would surrender it, and sent a small boat to request that the American vessel pull down its flag. Faithful to the words of his battle flag, "DON'T GIVE UP THE SHIP" (a paraphrase of the dying words of Captain James Lawrence, the ship's namesake and Perry's friend),[8] [9] Perry ordered the crippled *Lawrence* to fire a final salvo and then had his men row him a half-mile (0.8 km) through heavy gunfire to transfer his command to the USS *Niagara*. Once aboard, Perry dispatched the *Niagara's* commander, Captain Jesse Elliot, to bring the other schooners into closer action while he steered the *Niagara* toward the damaged British ships. Breaking through the British line, the American force pounded Barclay's ships until they could offer no effective resistance and surrendered. Although he had won the battle aboard the *Niagara*, he received the British surrender on the deck of the recaptured *Lawrence* to allow the British to see the terrible price his men had paid.[7] Perry's battle report to General William Henry Harrison was famously brief: "We have met the enemy and they are ours; two ships, two brigs, one schooner and one sloop."[8]

This was the first time in history that an entire British naval squadron had surrendered, and every captured ship was successfully returned to Presque Isle.[10] Although the engagement was small compared to Napoleonic naval battles such as the Battle of Trafalgar, the victory had disproportionate strategic importance, opening Canada up to possible invasion, while simultaneously protecting the entire Ohio Valley.[11] The loss of the British squadron directly led to the critical Battle of the Thames, the rout of British forces by Harrison's army, the death of Tecumseh, and the breakup of his Indian alliance. Along with the Battle of Plattsburgh, it was one of only two significant fleet victories of the war.

Perry-Elliott controversy

In his initial report, Perry praised Captain Elliott's role in the American victory at lake Erie. Once news of the battle spread, Perry and Elliott were both celebrated as national heroes. Soon after, however, several junior officers publicly criticized Elliott's performance during the battle, charging that Elliott allowed the *Lawrence* to suffer the brunt of the British fire while holding the *Niagara* back from the fight, and that he had only come to the aid of the *Lawrence* once he believed that Perry was dead. Elliot rejoined that there had been a lack of effective signaling. Charges were filed but were not officially acted upon. Attempting to restore his honor, Elliott and his supporters began a 30-year campaign that would outlive both men and ultimately leave his reputation in tatters.[10]

Congressional Gold Medal

On January 6, 1814, Perry was honored with a Congressional Gold Medal,[12] the Thanks of Congress, and a promotion to the rank of Captain.[13] [14] This was one of 27 Gold Medals authorized by Congress arising from the War of 1812.[15]

- **Obverse** -- bust of Perry facing right surrounded by *Oliverus H. Perry Princeps Stagno Eriense. ~ Classam Totam Contudit.*
- **Reverse** depicts a sea battle scene with inscriptions:

> *Viam Invenit Virtus Aut Facit*

Inter Class. Ameri.

Et Brit Die X. Sep.

MDCCCXIII

(Valor finds a way. Between the Fleets of America and Britain September 10, 1813.)[16] [17]

Elliott was also recognized with a Congressional Gold Medal[12] and the Thanks of Congress for his actions in the Battle of Lake Erie. This recognition would prove to fan the flames of resentment on both sides of the Elliott-Perry controversy.[10]

Later commands and controversies

In July 1814, Perry was offered command of the USS *Java*, a 44-gun frigate which was under construction in Baltimore. While overseeing the outfitting of the *Java*, Perry participated in the defenses of Baltimore and Washington, DC during the British invasion of the Chesapeake Bay. In a twist of irony, these land battles would be the last time the career naval officer saw combat. The Treaty of Ghent was signed before the *Java* could be put to sea.[6]

For Perry, the post-war years were marred by controversies. In 1815, he commanded the *Java* in the Mediterranean during the Second Barbary War. While moored in Naples, Perry was provoked into slapping the commander of the ship's Marines, John Heath. The ensuing court-martial found both men guilty but levied only mild reprimands. After the crew returned home, Heath challenged Perry to a pistol duel, which was fought on October 19, 1817, on the same Weehawken, New Jersey, field where Aaron Burr shot Alexander Hamilton. Heath fired first and missed. Perry refused to fire, satisfying the Marine's honor.[6]

Perry's return from the Mediterranean also reignited the feud with Elliott. After an exchange of angry letters, Elliott challenged Perry to a duel, which Perry refused. He instead decided to file formal court-martial charges against Elliott, including "conduct unbecoming an officer," and failure to "do his utmost to take or destroy the vessel of the enemy which it was his duty to encounter." Wishing to avoid a scandal between two congressionally decorated naval heroes, Secretary of the Navy Smith Thompson and President James Monroe suppressed the matter by offering Perry the rank of Commodore and a diplomatic mission to South America in exchange for dropping his charges against Elliott. This put an official end to the controversy, though it would continue to be debated for another quarter century.[18]

Death and legacy

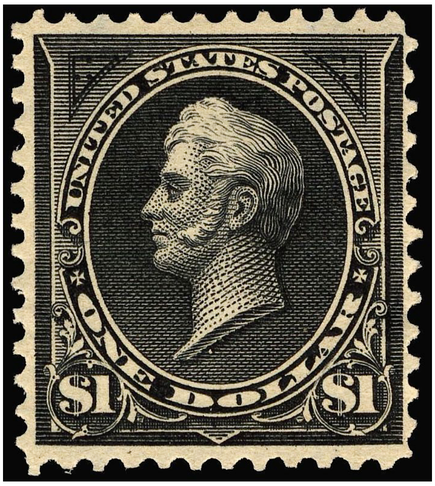
In 1819, after a successful expedition to Venezuela's Orinoco River to consult with Simon Bolivar about piracy in the Caribbean, Perry contracted yellow fever from mosquitoes while aboard the USS *Nonsuch*. Despite the crew's efforts to reach Trinidad for medical assistance, the Commodore died as the ship was nearing Port of Spain. He was 34 years old. After being buried in Port of Spain, his remains were later taken back to the United States and interred in Newport, Rhode Island. After resting briefly in the Old Common Burial Ground, his body was finally moved to Newport's Island Cemetery,[19] [20] where his brother Matthew C. Perry is also interred.[21]

His family's descendants include Commander John Rodgers, the second person to become a United States naval aviator,[22] and well known civilian aviator Calbraith Perry Rodgers, the first person to fly an airplane - the *Vin Fiz* - across the United States.[23]

Geographical namesakes

Many locations, both in Rhode Island and near Lake Erie, are named in his honor, including:

- The Village of Perryville in the Town of South Kingstown, Rhode Island.
- The City of Perryville, Arkansas.
- The City of Perrysville, Indiana.[24]
- The City of Perry, Michigan and Perry Township, Michigan.[25]
- The City of Perrysburg, Ohio.
- Perry, Ohio.
- Perry County, Kentucky and its county seat Hazard, Kentucky.[26] and the city of Perryville in Boyle County as well. Kentuckians were assigned as sharpshooters in the battle.
- The borough of Perryopolis, Pennsylvania.



Oliver Hazard PerryPostage stamps and postal history of the United States#Bureau issuesIssue of 1894

- Oliver Township, within Perry County, Pennsylvania.
- The Village of Perrysburg, New York and the surrounding township
- The Village of Perry, New York and the surrounding township[27]
- Most of Perry Counties in the U.S.[28]
- Perry Hall at Penn State Erie, The Behrend College.
- Camp Perry at Port Clinton, Ohio.
- The City of Perry, Georgia.
- Oliver Hazard Perry Schools in:San Diego, California; Chicago, Illinois; Cleveland and Euclid, Ohio; Boston and South Boston, Massachusetts; Brooklyn, New York; Pittsburgh, Pennsylvania; Providence, Rhode Island; and Lajas, Puerto Rico (built in 1904 and 1907) two classrooms.

Monuments

Monuments to Perry are located in many locations, including:

- Perry's Victory and International Peace Memorial at Put-In-Bay, Ohio — 352 foot (107 m) monument — the world's most massive Doric column — was constructed in Put-in-Bay, Ohio by a multi-state commission from 1912 to 1915.[29]
- Perry Monument at Misery Bay, Presque Isle State Park in Erie, Pennsylvania
- Front Park, in Buffalo, New York
- Wade Park in Cleveland, Ohio
- Perry Square in Erie, Pennsylvania
- Island Cemetery in Newport, RI

Oliver Hazard Perry Throck Morton — the 14th Governor of Indiana, a famous Republican politician and U.S. Senator who was a leader among the Radical Republican reconstructionists — was named in his honor.

Eponymous ships

Commodore Perry has been repeatedly honored with ships bearing his name.

- USS *Perry* (1843), a sailing brig 1843–1865.
- USS Commodore Perry (1859) was an armed side wheel ferry built in 1859 by Stack and Joyce, Williamsburg, N.Y. and purchased by the Navy 2 October 1861; and commissioned later in the month, Acting Master F. J. Thomas was in command.[30]
- USS *Perry* (DD-11), *Bainbridge*-class destroyer 1900–1919.
- USS *Perry* (DD-340), a *Clemson*-class destroyer converted into a high speed minesweeper and redesignated DMS–17 effective 19 November 1940. Served 1921–1944; sunk in Battle of Peleliu.
- Oliver Hazard Perry - USAT 2725 a Liberty ship. *See,* List of Liberty ships: M-R.[31]
- USS *Perry* (DD-844), was a Gearing class destroyer 1945–1970.
- USS *Oliver Hazard Perry* (FFG-7), a guided-missile frigate 1976–1997 and Oliver Hazard Perry class frigates are named in his honor. *See also* USS Perry.
- SSV Oliver Hazard Perry Rhode Island Educational [32] Tall ship. When completed, it will measure 207 feet (63 m), will be a three-masted Square-rigged vessel, making it the largest privately-owned tall ship in the United States. Scheduled to set sail in 2012, it is intended to be a 'good will ambassador' for the State of Rhode Island, and a "floating classroom." It is being financed through a tax exempt 501(c)(3) charitable foundation, and public subscription.[32] [33] Ironically, "The ship, as it existed [when acquired by the Rhode Island trust was] a 138 feet (42 m) steel hull, which [was] bought from an organization in Ontario for $325,000. It had cost almost $3 million to build, but the Canadian group derailed before the ship--intended to be a replica of the [20 gun] British ship HMS Detroit [captured by the flotilla commanded by Commodore Perry -- not the six gun sloop HMS Detroit (1812) destroyed by Lieutenant Jesse D. Elliott in the War of 1812] -- could be completed."[33] [34]

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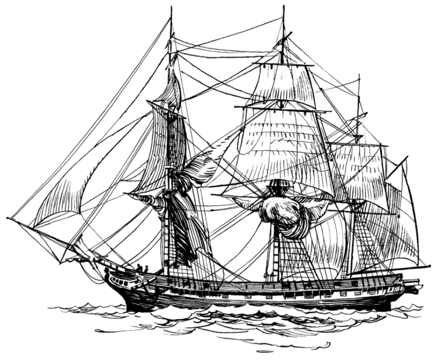
Frigate



Sailing frigate

A **frigate** (pronounced /ˈfrɪɡɨt/) is any of several types of warship, the term having been used for ships of various sizes and roles over the last few centuries.

In the 17th century, the term was used for any warship built for speed and maneuverability, the description often used being "frigate-built". These could be warships carrying their principal battery of carriage-mounted guns on a single deck or on two decks (with further smaller carriage-mounted guns usually carried on the forecastle and quarterdeck of the vessel). The term was generally used for ships too small to stand in the line of battle, although early line-of-battle ships were frequently referred to as frigates when they were built for speed.

In the 18th century, the term referred to ships which were usually as long as a ship-of-the-line and were square-rigged on all three masts (full rigged), but were faster and with lighter armament, used for patrolling and escort. In the definition adopted by the British Admiralty, they were rated ships of at least 28 guns, carrying their principal armament upon a single continuous deck—the upper deck, while ships-of-the-line possessed two or more continuous decks bearing batteries of guns.

Frigates did not carry any guns (or have any gunports) on their lower decks; confusingly, the lower deck was often referred to as the "gun deck" in the Royal Navy (in the American Navy, it was usually called the "berth deck"), even for frigates, where it did not carry any guns or have gunports. Both types could (and usually did) additionally carry smaller carriage-mounted guns on their quarter decks and forecastles (the superstructures above the upper deck). Technically, rated ships with fewer than 28 guns could not be classed as frigates but as "post ships"; however, in common parlance most post ships were often described as "frigates", the same casual misuse of the term being extended to smaller two-decked ships that were too small to stand in the line of battle.

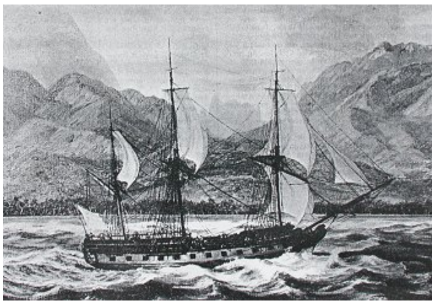
In the late 19th century (beginning about 1858 with the construction of prototypes by the British and French navies), the **armoured frigate** was a type of ironclad warship and for a time was the most powerful type of vessel afloat. The term "frigate" was used because such ships still mounted their principal armament on a single continuous upper deck. The later 19th century battleship thus developed from the frigate rather than from the ship of the line.

In modern navies, frigates are used to protect other warships and merchant-marine ships, especially as anti-submarine warfare (ASW) combatants for amphibious expeditionary forces, underway replenishment groups, and merchant convoys. Ship classes dubbed "frigates" have also more closely resembled corvettes, destroyers, cruisers and even battleships.

The rank Frigate Captain derives from the name of this type of ship.

Age of sail

Origins



Boudeuse, of Louis Antoine de Bougainville

The term "frigate" (Italian: *fregata*; Spanish/Catalan/Portuguese/Sicilian: *fragata*; Dutch: *fregat*) originated in the Mediterranean in the late 15th century, referring to a lighter galleass type ship with oars, sails and a light armament, built for speed and maneuverability.[1]

In 1583, during the Eighty Years' War, Habsburg Spain recovered the Southern Netherlands from the rebellious Dutch. This soon led to the occupied ports being used as bases for privateers, the Dunkirkers, to attack the shipping of the Dutch and their allies. To achieve this they developed small, maneuverable, sail-only vessels that came to be referred to as frigates. The success of these Dunkirker vessels influenced the ship design of the Dutch and other navies contending with them but because most regular navies required ships of greater endurance than the Dunkirker frigates could provide, the term was soon applied less exclusively to any relatively fast and elegant sail-only war ship. Even the mighty English *Sovereign of the Seas* was described as 'a delicate frigate' after modifications in 1651.

The navy of the Dutch Republic was the first regular navy to build the larger ocean-going frigates. The Dutch navy had three principal tasks in the struggle against Spain: to protect Dutch merchant ships at sea, to blockade the ports of Spanish-held Flanders to damage trade and halt enemy privateering, and to fight the Spanish fleet and prevent troop landings. The first two tasks required speed, shallowness of draft for the shallow waters around the Netherlands, and the ability to carry sufficient supplies to maintain a blockade. The third task required heavy armament, sufficient to fight against the Spanish fleet. The first of these larger battle-capable frigates were built around 1600 at Hoorn in Holland.[2] By the later stages of the Eighty Years War the Dutch had switched entirely from the heavier ships still used by the English and Spanish to the lighter frigates, carrying around 40 guns and weighing around 300 tons.

The effectiveness of the Dutch frigates became most visible in the Battle of the Downs in 1639, triggering most other navies, especially the English, to adopt similar innovations.

The fleets built by the Commonwealth of England in the 1650s generally consisted of ships described as "frigates", the largest of which were two-decker 'great frigates' of the third rate. Carrying 60 guns, these vessels were as big and capable as 'great ships' of the time; however, most other frigates at the time were used as 'cruisers': independent fast ships. The term "frigate" implied a long hull design, which relates directly to speed (see hull speed) and also, in turn, helped the development of the broadside tactic in naval warfare.

At this time a further design evolved, reintroducing oars to create the galley frigate such as the *Charles Galley* of 1676 which was rated as a 32-gun fifth rate but also had a bank of 40 oars set below the upper deck which could be used to propel the ship in the absence of a favourable wind.

In French, the term "frigate" became a verb, meaning 'to build long and low', and an adjective, adding further confusion.[3]
In Danish, the word "fregat" is often applied to warships carrying as few as 16 guns,such as HMS Falcon (1802) which the British classified as a sloop.

Under the rating system of the Royal Navy, by the middle of the 18th century, the term "frigate" was technically restricted to single-decked ships of the fifth rate, though small 28-gun frigates were classed as sixth rate.[1]

Classic design

A *Magicienne*-class frigate

The classic sailing frigate, well-known today for its role in the Napoleonic wars, can be traced back to French developments in the second quarter of the 18th century. The French-built *Médée* of 1740 is often regarded as the first example of this type. These ships were square-rigged and carried all their main guns on a single continuous upper deck. The lower deck, known as the "gun deck", now carried no armament, and functioned as a "berth deck" where the crew lived, and was in fact placed below the waterline of the new frigates.

The new sailing frigates were able to fight with all their guns when the seas were so rough that comparable two-deckers had to close the gun-ports on their lower decks (see the Action of 13 January 1797, for an example when this was decisive). Like the larger 74 which was developed at the same time, the new frigates sailed very well and were good fighting vessels due to a combination of long hulls and low upperworks compared to vessels of comparable size and firepower.

The Royal Navy captured a handful of the new French frigates during the War of the Austrian Succession (1740–1748) and were impressed by them, particularly for their inshore handling capabilities. They soon built copies and started to adapt the type to their own needs, setting the standard for other frigates as a superpower. The first British frigates carried 28 guns including an upper deck battery of twenty-four 9-pounder guns (the remaining four smaller guns were carried on the quarter deck) but soon developed into fifth-rate ships of 32 or 36 guns including an upper deck battery of twenty-six 12-pounder guns (with the remaining six or ten smaller guns carried on the quarter deck and forecastle). From around 1778, a larger "heavy" frigate was developed with a main battery of twenty-six or twenty-eight 18-pounder guns (again with the remaining ten smaller guns carried on the quarter deck and forecastle).

Royal Navy frigates of the late 18th century included the 1780-vintage *Perseverance* class, which measured around 900 tons burthen and carried 36 guns; this successful class was followed by numerous other classes that measured over 1,000 tons burthen and carried 38 guns.

USS *Constitution*

In 1797, three of the US Navy's first six major ships were rated as 44-gun frigates (or "super-frigates"), which operationally carried fifty-six to sixty 24-pounder long guns and 36-pounder or 48-pounder carronades on two decks; by all regards they were exceptionally powerful and tough. These ships were so well-armed that they were often regarded as equal to ships of the line, and after a series of losses at the outbreak of the War of 1812, Royal Navy fighting instructions ordered British frigates (usually of 38 guns or less) to never engage American frigates at any less than a 2:1 advantage. USS *Constitution*, preserved as a museum ship by the US Navy, is the oldest commissioned frigate afloat, and is a surviving example of a frigate from the Age of Sail. *Constitution* and her two sister ships (USS *President* and USS *United States*) were created in a response to deal with the Barbary Coast pirates and in conjunction with the Naval Act of 1794. The three big frigates, when built, had a distinctive building pattern which minimised "hogging" (in which the centre of the keel rises while both ends drop) and improves hydrodynamic efficiency.[4]

The hull was designed so that all the weight from the guns was upon the keel itself. Joshua Humphreys proposed that only live oak, a tree that grew only in America, should be used to build these ships. The method was to use diagonal riders, eight on each side that sat a 45 degree angle. These beams of live oak were about two feet wide and around a foot thick and helped to maintain the shape of the hull, serving also to reduce flexibility and to minimize impacts.[4] These ideas were considered revolutionary in the late 18th and early 19th century. A three-layer method was used in which the planks along the sides of the hull were laid horizontally across the ribs, making a crossing or checker board pattern. The sides of the ship could be as thick as 25 inches, and were able to absorb substantial damage. The strength of this braced construction earned USS *Constitution* the nickname "Old Ironsides".

Role

Frigates were perhaps the hardest-worked of warship types during the Age of Sail. While smaller than a ship-of-the-line, they were formidable opponents for the large numbers of sloops and gunboats, not to mention privateers or merchantmen. Able to carry six months' stores, they had very long range; and vessels larger than frigates were considered too valuable to operate independently.

Frigates scouted for the fleet, went on commerce-raiding missions and patrols, conveyed messages and dignitaries. Usually frigates would fight in small numbers or singly against other frigates. They would avoid contact with ships-of-the-line; even in the midst of a fleet engagement it was bad etiquette for a ship of the line to fire on an enemy frigate which had not fired first.

For officers in the Royal Navy a frigate was a desirable posting. Frigates often saw action, which meant a greater chance of glory, promotion, and prize money.

Unlike larger ships that were placed in ordinary, frigates were kept in service in peacetime as a cost-saving measure and to provide experience to frigate captains and officers which would be useful in wartime. Frigates could also carry marines for boarding enemy ships or for operations on shore.

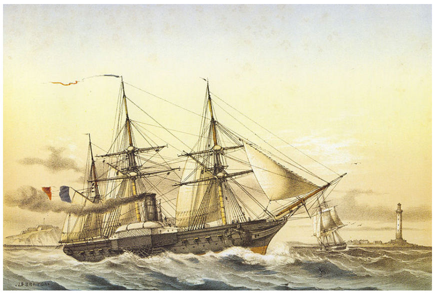
The fictitious, but representative, ironclad frigate USS *Abraham Lincoln*, from Jules Verne's the novel *Twenty Thousand Leagues Under the Sea*

Common armament was one gundeck with 32 to 44 long guns, from 8- to 24-pounders (3.6 to 11 kg), plus a few carronades (large bore short-range guns).

Frigates remained a crucial element of navies until the mid-19th century. The first ironclads were classified as "frigates" because of the number of guns they carried. However, terminology changed as iron and steam became the norm, and the role of the frigate was assumed first by the protected cruiser and then by the light cruiser.

Frigates are often the vessel of choice in historical naval novels due to their relative freedom compared to ships of the line (kept for fleet actions) and smaller vessels (generally assigned to a home port and less widely ranging). For example the Patrick O'Brian Aubrey–Maturin series, C. S. Forester's Horatio Hornblower series and Alexander Kent's Richard Bolitho series. The motion picture *Master and Commander* features a reconstructed historic frigate, HMS *Rose*, to depict Aubrey's frigate HMS *Surprise*.

Age of steam


French paddle frigate *Descartes*

Vessels classed as frigates continued to play a great role in navies with the adoption of steam power in the 19th century. In the 1830s navies experimented with large paddle steamers equipped with large guns mounted on one deck, which were termed "paddle frigates".

From the mid-1840s frigates which more closely resembled the traditional sailing frigate were built with steam engines and screw propellers. These "screw frigates", built first of wood and later of iron, continued to perform the traditional role of the frigate until late in the 19th century.

Armoured frigate

From 1859, armour was added to ships based on existing frigate and ship of the line designs. The additional weight of the armour on these first ironclad warships meant that they could have only one gun deck, and they were technically frigates, even though they were more powerful than existing ships-of-the-line and occupied the same strategic role. The phrase "armoured frigate" remained in use for some time to denote a sail-equipped, broadside-firing type of ironclad.

Towards the end of the 19th century, the term "frigate" fell out of use. Vessels with armoured sides were designated as "battleships" or "armoured cruisers", while "protected cruisers" only possessed an armoured deck, and unarmoured vessels, including frigates and sloops, were classified as "unprotected cruisers".

Modern Age

Second World War

A Loch-class frigate

Modern frigates are related to earlier frigates only by name. The term "frigate" was readopted during World War II by the Royal Navy to describe a new type of anti-submarine escort vessel that was larger than a corvette, but smaller than a destroyer. The frigate was introduced to remedy some of the shortcomings inherent in the corvette design: limited armament, a hull form not suited to open-ocean work, a single shaft which limited speed and maneuverability, and a lack of range.

The frigate was designed and built to the same mercantile construction standards (scantlings) as the corvette, allowing manufacture by yards unused to warship construction. The first frigates of the River class (1941) were essentially two sets of corvette machinery in one larger hull, armed with the latest Hedgehog anti-submarine weapon.

The frigate possessed less offensive firepower and speed than a destroyer, but such qualities were not required for anti-submarine warfare. Submarines were slow, and ASDIC sets did not operate effectively at speeds of over 20 knots. Rather, the frigate was an austere and weatherly vessel suitable for mass-construction and fitted with the latest innovations in anti-submarine warfare. As the frigate was intended purely for convoy duties, and not to deploy with the fleet, it had limited range and speed.

The contemporaneous German *Flottenbegleiter* ("fleet escorts"), also known as "F-Boats" were essentially frigates.[5] They were based on a pre-war *Oberkommando der Marine* concept of vessels which could fill roles such as fast minesweeper, minelayer, merchant escort and anti-submarine vessel. Because of the Treaty of Versailles their displacement was officially limited to 600 tons, although in reality they exceeded this by about 100 tons. F-boats had two stacks and two 105 mm gun turrets. The design was flawed because of its narrow beam, sharp bow and unreliable high pressure steam turbines. F-boats were succeeded in operational duties by Type 35 and Elbing-class torpedo boats. *Flottenbegleiter* remained in service as advanced training vessels.

It was not until the Royal Navy's Bay class of 1944 that a British design bearing the name of frigate was produced for fleet use, although it still suffered from limited speed. These anti-aircraft frigates, built on incomplete Loch-class frigate hulls, were similar to the United States Navy's destroyer escorts (DE), although the latter had greater speed and offensive armament to better suit them to fleet deployments. American DEs serving in the British Royal Navy were rated as frigates, and British-influenced *Tacoma*-class frigates serving in the USN were classed as patrol frigates (PF).

Guided missile role

The introduction of the surface-to-air missile after the Second World War made relatively small ships effective for anti-aircraft warfare: the "guided missile frigate." In the USN, these vessels were called "ocean escorts" and designated "DE" or "DEG" until 1975 - a holdover from the World War II destroyer escort or "DE". The British Royal Navy maintained the use of the term "frigate"; likewise, the French Navy refers to missile-equipped ship, up to cruiser-sized ships, by the name of "frigate", while smaller units are named aviso. Soviet Navy used the term "guard-ship" (*сторожевой корабль*).

From the 1950s to the 1970s, the USN commissioned ships classed as guided missile frigates which were actually anti-aircraft warfare cruisers built on destroyer-style hulls. Some of these ships—the *Bainbridge*-, *Truxtun*-, *California*- and *Virginia*- classes—were nuclear-powered. These were larger than any previous frigates and the use of the term '"frigate"' here is much more analogous to its original use. All such ships were reclassified as guided missile cruisers (CG/CGN) or, in the case of the smaller *Farragut* class, as guided missile destroyers (DDG) in 1975. The last of these particular frigates were struck from the Naval Vessel Register in the 1990s.

One of the most successful post-1945 designs was the British *Leander*-class frigate, which was used by several navies. Laid down in 1959, the *Leanders* were based on the previous Type 12 anti-submarine frigate but equipped for anti-aircraft use as well. They were used by the UK into the 1990s, at which point some were sold onto other navies. The *Leander* design, or improved versions of it, were licence-built for other navies.

Nearly all modern frigates are equipped with some form of offensive or defensive missiles, and as such are rated as guided-missile frigates (FFG). Improvements in surface-to-air missiles (e.g., the Eurosam Aster 15) allow modern guided-missile frigates to form the core of many modern navies and to be used as a fleet defence platform, without the need for specialised anti-air warfare frigates.

Other uses

The Royal Navy Type 61 *Salisbury* class were "air direction" frigates equipped to track aircraft. To this end they had reduced armament compared to the Type 41 *Leopard*-class air-defence frigates built on the same hull.

Anti-submarine role

At the opposite end of the spectrum, some frigates are specialised for anti-submarine warfare. Increasing submarine speeds towards the end of the Second World War (see German Type XXI submarine) greatly reduced the margin of speed superiority of frigate over submarine. The frigate could no longer be slow and powered by mercantile machinery and consequently postwar frigates, such as the *Whitby* class, were faster.

Such ships carry improved sonar equipment, such as the variable depth sonar or towed array, and specialised weapons such as torpedoes, forward-throwing weapons such as Limbo and missile-carried anti-submarine torpedoes such as ASROC or Ikara. Surface-to-air missiles such as Sea Sparrow and surface-to-surface missiles such as Exocet give them defensive and offensive capabilities. The Royal Navy's original Type 22 frigate is an example of a specialised anti-submarine warfare frigate.

HMS *Somerset* of the Royal Navy. Type 23 frigates were built for anti-submarine warfare but are capable multi-purpose ships.[6]

Especially for anti-submarine warfare, most modern frigates have a landing deck and hangar aft to operate helicopters, eliminating the need for the frigate to close with unknown sub-surface threats, and using fast helicopters to attack nuclear submarines which may be faster than surface warships. For this task the helicopter is equipped with sensors such as sonobuoys, wire-mounted dipping sonar and magnetic anomaly detectors to identify possible threats, and torpedoes or depth-charges to attack them.

With their onboard radar helicopters can also be used to reconnoitre over-the-horizon targets and, if equipped with anti-ship missiles such as Penguin or Sea Skua, to attack them. The helicopter is also invaluable for search and rescue operation and has largely replaced the use of small boats or the jackstay rig for such duties as transferring personnel, mail and cargo between ships or to shore. With helicopters these tasks can be accomplished faster and less dangerously, and without the need for the frigate to slow down or change course.

Further developments

Stealth technology has been introduced in modern frigate design. Frigate shapes are designed to offer a minimal radar cross section, which also lends them good air penetration; the maneuverability of these frigates has been compared to that of sailing ships. Examples are the French *La Fayette* class with the Aster 15 missile for anti-missile capabilities, the German F125 class and *Sachsen*-class frigates and the Turkish TF-2000 type frigates with the MK-41 VLS.

The modern French Navy applies the term first-class frigate and second-class frigate to both destroyers and frigates in service. Pennant numbers remain divided between F-series numbers for those ships internationally recognised as frigates and D-series pennant numbers for those more traditionally recognised as destroyers. This can result in some confusion as certain classes are referred to as frigates in French service while similar ships in other navies are referred to as destroyers.

Shivalik-class frigate of the Indian Navy.

This also results in some recent classes of French ships being among the largest in the world to carry the rating of frigate.

In the German Navy frigates were used to replace aging destroyers; however in size and role the new German frigates exceed the former class of destroyers. The future German F125-class frigate will be the largest class of frigates worldwide with a displacement of more than 7,200 tons. The same was done in the Spanish Navy, which went ahead with the deployment of the first Aegis frigates, the F100 class frigates.

Some new classes of ships similar to corvettes are optimised for high-speed deployment and combat with small craft rather than combat between equal opponents; an example is the U.S. Littoral Combat Ship.

Gallery

ARC *Almirante Padilla*, a Colombian *Padilla*-class light missile frigate

Spanish *Álvaro de Bazán*-class frigate

HMAS *Darwin*, an Australian *Adelaide*-class frigate

De Zeven Provinciën-class frigate.

HMS *Swale* of the River class

PLAN Type 054A frigate.

South African Valour-class frigate, SAS Spioenkop (F147).

Maestrale-class frigate of the Italian Navy

HNLMS *Van Speijk*, a Dutch *Karel Doorman*-class frigate

Sachsen-class frigate of the German navy

USS *Vandegrift*, an American *Oliver Hazard Perry*-class frigate

HMCS *Regina*, a Canadian *Halifax*-class frigate

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- Frigates (http://www.destroyersonline.com/usndd/fftypes.htm?) from Destroyers OnLine - pictures, history, crews of United States frigates since 1963
- The Development of the Full-Rigged Ship From the Carrack to the Full-Rigger (http://www.greatgridlock.net/Sqrigg/squrig2.html)

About The Rentz

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USS Rentz (FFG-46)USS Rentz (FFG-46) Career (US) Namesake: Chaplain George S. RentzBuilder:Todd Pacific Shipyards, San PedroLaid down: 18 September 1982Launched: 16 July 1983Commissioned: 30 June 1984Homeport:Naval Base San DiegoMotto:Dread NoughtStatus: in active service, as of 2011Badge:USS Rentz crest General characteristics Class and type:Oliver Hazard Perry class frigateOliver Hazard Perry-class frigateDisplacement: 4100 long tons (4200 t), full loadLength: 453 feet (138 m), length overalloverallBeam: 45 feet (14 m)Draught: 22 feet (6.7 m)Propulsion: 2 × General Electric LM2500General Electric LM2500-30 gas turbines generating 41000 shp (31000 kW) through a single propeller shaftshaft and Controllable pitch propellervariable pitch propeller2 × Bow thrusterAuxiliary Propulsion Units, 350 horsepowerhp (260 kW) retractable electric Azimuth thrusterazipods for maneuvering and docking.Speed: over 29 knots (54 km/h)Range: 5000 nautical miles at 18 knots (9300 km at 33 km/h)Complement: 15 officers and 190 enlisted, plus SH-60 SeahawkSH-60 LAMPS detachment of roughly six officer pilots and 15 enlisted maintainersSensors andprocessing systems:AN/SPS-49 air-search radarAN/SPS-55 surface-search radarCAS and STIR fire-control radarAN/SQS-56 sonar.Electronic warfare and decoys:AN/SLQ-32Armament:As built:One OTO Melara 76 mm naval gunOTO Melara Mk 75 76 mm/62 caliber naval guntwo Mark 32 Surface Vessel Torpedo TubesMk 32 triple-tube (324 mm) launchers for Mark 46 torpedoMark 46 torpedoesone Vulcan Phalanx CIWSPhalanx CIWS; four M2 Browning machine gun.50-cal (12.7 mm) machine guns.one Mk 13 Mod 4 single-arm launcher for Boeing HarpoonHarpoon anti-ship missiles and RIM-66 StandardSM-1MR Standard anti-ship/air missiles (40 round magazine)Note: As of 2004, Mk13 systems removed from all active US vessels of this class.Aircraft carried: 2 × SH-60 SeahawkSH-60 LAMPS III helicoptersUSS Rentz (FFG-46) is an Oliver Hazard Perry class frigateOliver Hazard Perry-class of guided missile frigate, of the United States Navy, the 40th ship to be constructed of its class. The Rentz was named after World War II Navy Chaplain George S. Rentz (1882–1942). Chaplain Rentz was posthumously awarded the Navy Cross for selfless bravery following the loss of USS Houston (CA-30)USS Houston in the Battle of Sunda Strait. He was the only Navy chaplain to be so honored during World War II.History The keel of Rentz was laid on 18 September 1982 at Todd Pacific Shipyards in San Pedro, California. She was launched 16 July 1983, and commissioned at Naval Station Long Beach on 30 June 1984 under the command of CommanderCDR Martin Jules Mayer (b. 1944).Nguyen, Lisa. "Martin Mayer Collection (AFC/2001/001/49389), Veterans History Project". Library of Congress. . Retrieved 2008-09-18. In attendance were survivors of the Houston, as well as Chaplain Rentz's surviving daughter.In December, 1985, Rentz moved from Long Beach, California to its current (2007) location in San Diego, California. Following initial shakedown cruises and operations, Rentz was assigned to the USS Ranger (CV-61)USS Ranger aircraft carrier group. As part of that group, the ship regularly cruised the Southern California Operations Area off the coast of San Clemente Island with a pair of fuzzy dice dangling above the ship's computerized helm. During "breakaways" after underway replenishment (UNREP) at sea, Rentz blasted the Beach Boys song "Little Deuce Coupe" as its inaugural "Breakaway musicUNREP breakaway song."On 5 November 1986, Rentz was part of an historic visit to Qingdao (Tsing Tao; □□) People's Republic of ChinaChina—the first US Naval visit to China since 1949. Rentz was accompanied by two other ships, the USS Reeves (CG-24)Reeves and USS Oldendorf (DD-972)Oldendorf. The visit was officially hosted by the Chinese People's Liberation Army Navy (PLAN)."After 37-year absence, U.S. vessels visit China". New York Times: A3. November 6, 1986. Previously, the USS Dixie (AD-14)USS Dixie was the last ship to moor in China, departing in 1949 when the communists forced the Americans to leave the Chinese mainland.In July 1987, Rentz was sent to the Persian Gulf as part of Operation Earnest Will. Her primary duties consisted of escorting commercial vessels through the Strait of Hormuz. "Rentz" provided missile security escort for the North Persian Gulf Battlegroup destroyers during their transit in and out of the Straits of Hormuz en route to an operation code name "Nimble Archer" involving naval gun bombardment and SEAL Team take over of an abandoned oil rig being used by the Iranian Revolutionary Guard to stage attacks on Persian Gulf shipping. Rentz has been deployed to the Gulf numerous times since 1987.On November 28, 2009 while the ship was moored in Jebel Ali, United Arab Emirates as part of the Nimitz carrier strike group, a crewman was killed while performing repairs to the ship. According to the Navy, Petty Officer 3rd Class David M. Mudge"{http://www.defense.gov/releases/release.aspx?releaseid=13157] was electrocuted while working in an auxiliary machinery space.Military Times, " Rentz sailor electrocuted aboard ship", November 30, 2009. In response to the mishap, the Navy ordered the entire fleet to inspect ship electrical enclosures.Liewer, Steve, "Sailor’s Death Prompts Navy To Act", San Diego Union-Tribune, January 11, 2010.Awards "outstanding food service" in the Pacific Fleet, 1997 Ney Award winner "Small Afloat." "outstanding food service" in the Pacific Fleet, 2000 Ney runner-up "Small Afloat." 2003 Mobility Energy Efficiency award from the Federal Emergency Management Agency.About the Ship's Crest The colors blue and gold are traditionally associated with the U.S. Navy. The vertical trident represents the sea god Neptune. The crossed missiles indicate the type of ship "Frigate with Guided Missiles." The cross on the shield symbolizes the ship's namesake, Chaplain Rentz. The motto "Dread Nought" tells all to have no fear for the ship is watched over by higher powers. References This article includes information collected from the Naval Vessel Register, which, as a U.S. government publication, is in the public domain. The entry can be found here.External links USS Rentz official website navsource.org: USS Rentz navysite.de: USS Rentz USS Rentz at Destroyer History U.S. NAVY HELO CREW RESCUED BY USS RENTZ, COMNAVAIRPAC Press Release 1997: PR97-015 MaritimeQuest USS Rentz FFG-46 pages Defense Visual Information Center (search for "Rentz")

George S. Rentz

George Snavely Rentz	
July 25, 1882 – March 1, 1942 (aged 59)	
CDR George S. Rentz	
Place of birth	Lebanon, Pennsylvania
Place of death	Pacific Ocean
Allegiance	United States of America
Service/branch	United States Navy
Rank	Commander
Battles/wars	World War I World War II • Battle of Makassar Strait • Battle of Sunda Strait
Awards	Navy Cross

George Snavely Rentz (July 25, 1882 – March 1, 1942) was a United States Navy chaplain who served during World War I and World War II. For selfless heroism following the loss of USS *Houston* (CA-30) in the Battle of Sunda Strait, he was posthumously awarded the Navy Cross— the only Navy Chaplain to be so honored during World War II.

Personal history

Born in Lebanon, Pennsylvania, George Rentz received his undergraduate degree from Gettysburg College in 1903, which was at the time known as Pennsylvania College, and then graduated from Princeton Theological Seminary. He was ordained in 1909 and for the next eight years served as a Presbyterian minister for the Presbytery of Northumberland, as well as pastoring churches in Pennsylvania and New Jersey.

Upon the entry of the United States in World War I, he was appointed acting chaplain with the rank of Lieutenant Junior Grade and assigned to the 11th Marine Regiment in France where he served until 1919. Rentz attained the rank of Commander in 1924. As chaplain, he served aboard USS *Florida* (BB-30), USS *Wright* (AV-1), USS *West Virginia* (BB-48), USS *Augusta* (CA-31) and his final duty station, *Houston*. During his military career, Rentz also served at the Marine Barracks in Port Royal, South Carolina, Naval Air Station Pensacola, Florida, and Naval Air Station San Diego, California.

Commander Rentz transferred from the *Augusta* to the *Houston* in 1940 when it relieved *Augusta* as the flagship of the Asiatic Fleet. Rentz was a crew favorite, even going so far as to ignore regulations and dispense nips of alcohol as needed to the exhausted sailors.[1]

Sinking of the USS Houston

During a Japanese attack on *Houston* at the Battle of Makassar Strait on February 4, 1942, Commander Rentz spurned cover and circulated among the crew of the anti-aircraft battery, keeping up their spirits. It was noted that, when crew members at the guns "… saw this man of God, walking fearlessly among them, they no longer felt alone."[2] In the Flores Sea, during this attack, *Houston* took a direct hit that disabled turret III and killed 48 men.

Less than a month later, *Houston* and the Australian light cruiser HMAS *Perth* (D29) were directed to proceed to Ceylon where they were supposed to attack Japanese naval supply lines. En route, the two ships unexpectedly encountered a Japanese invasion force resulting in the encounter now known as the Battle of Sunda Strait. Though outnumbered by the Japanese convoy, both ships persisted. In the ensuing melee one of the Japanese destroyers fired a spread of torpedoes that passed by the allied cruisers and sunk four of their own troopships. In the end, the Japanese forces proved too much for the wounded *Perth* and *Houston.* The final attack on these two cruisers sank first *Perth* and then *Houston* shortly before midnight on March 1, 1942.

Eyewitness accounts of heroism

It was during the abandonment of the sinking *Houston* that Commander Rentz entered the water and attained partial safety along with other crewmembers on a destroyed airplane's float. Seeing extreme overcrowding and the fact that the pontoon was taking on water, he attempted to relinquish his space and lifejacket to wounded survivors nearby. He declared "You men are young, I have lived the major part of my life and I am willing to go."[3] According to *Houston* survivor Private Jim Gee, no one would oblige the generous, fearless chaplain. Each time Rentz attempted to leave he was brought back by his shipmates. He ultimately relinquished his lifejacket to Seaman First Class Walter L. Beeson, who recounts that Rentz "told me his heart was failing him; told me he couldn't last much longer." Following a brief prayer, the Chaplain gave the lifejacket to Beeson who refused to put it on. Rentz kicked away from the float and disappeared. Gee recalled "No one realized what had happened. It's just one of those things that one minute he's there, and the next minute... he wasn't." When Beeson realized that Rentz was gone, he put on the lifejacket.[4] For these actions, Rentz was posthumously awarded the United States Navy's second highest award for valor, the Navy Cross.

Chaplain Rentz had less than one year to serve before retiring. He was one of 800 men who perished out of the original crew of 1,168 aboard *Houston*. Of the 368 crew members who made it to shore and were captured by the Japanese, 291 would survive to the end of the war.[5]

Namesake

The *Oliver Hazard Perry*-class frigate USS *Rentz* (FFG-46) is named in his honor.

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[2] Schulz, p. ??

[3] Schulz, p. 204

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[5] Hornfischer, p. 2; p. 149

External links

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- USS *Rentz* official website (http://www.rentz.navy.mil/)
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Todd Pacific Shipyards

Todd Pacific Shipyards Corporation was founded in 1916 as the William H. Todd Corporation through the merger of Robins Dry Dock & Repair Company of Erie Basin, Brooklyn, New York, the Tietjen & Long Dry Dock Company of Hoboken, New Jersey, and the Seattle Construction and Dry Dock Company. The Seattle shipyard could trace its history back to 1882, when Robert Moran opened a marine repair shop at Yesler's Wharf. This shop became the Moran Brothers Shipyard in 1906 and the Seattle Construction & Dry Dock Company at the end of 1911.

Todd has performed building and maintenance work for, among others, the U.S. and Royal Australian Navies, the United States Coast Guard, and the Washington State Ferries. Its headquarters and operations are on Harbor Island at the mouth of Seattle's Duwamish Waterway.

Todd's shares trade on the New York Stock Exchange under the ticker symbol TOD. Todd Pacific Shipyards Corporation is a wholly-owned subsidiary of Todd Shipyards Corporation.[1]

The 105-foot (32 m)-long hull of Disneyland's Mark Twain Riverboat was built at Todd Shipyards in San Pedro, California in 1955.

In December 2010, Vigor Industrial announced plans to buy Todd for $130 million.[2]

Divisions

- Seattle Division, Seattle, Washington. (47°35′10″N 122°21′25″W)
- Los Angeles Division, San Pedro, California. (33°45′11″N 118°16′48″W) Formerly Los Angeles Shipbuilding & Dry Dock Corporation, closed in 1989 following completion of its Oliver Hazard Perry class frigate contract and after failing to win an Arleigh Burke class destroyer contract.[3] Property is now part of the Port of Los Angeles, and has been completely converted into Berth 100 / West Basin Container Terminal.[4]
- San Francisco Division, Alameda, California. (37°47′N 122°17′W) Opened 1901, by United Engineering Company, later named Bethlehem-Alameda Shipyard, then Todd San Francisco Division, 1949. Now closed.[5] Documented by the Historic American Engineering Record as United Engineering Company Shipyard, survey HAER CA-295 [6].
  - Mostly used as a repair or conversion facility

TODD
PACIFIC SHIPYARDS CORPORATION
REID FFG-30
KEEL LAID OCTOBER 8 1980
LAUNCH DATE JUNE 27 1981
TODD PACIFIC SHIPYARDS CORPORATION LOS ANGELES DIVISION

Master of Ceremonies and Vice President of Todd Pacific Shipyards Corporation, Hans K. Schaefer, speaks during christening and launching ceremonies for the guided missile frigate USS *Reid* (FFG-30) at the Todd Pacific Shipyards Corp., Los Angeles Division, 1981.

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[2] "Rapid Fire: 2010-12-27" (http://www.defenseindustrydaily.com/Rapid-Fire-2010-12-27-06705/). . Retrieved 2011-01-02.

[3] GlobalSecurity.org. Todd Los Angeles Division (http://www.globalsecurity.org/military/facility/san-pedro-todd.htm).

[4] Port of Los Angeles. Container Facilities (http://www.portoflosangeles.org/facilities_Container.htm). Shows an aerial view of Berth 100, the former location of Todd - San Pedro.

[5] GlobalSecurity.org. Todd San Francisco Division (http://www.globalsecurity.org/military/facility/alameda-todd.htm).

External links

- Todd Pacific Shipyards homepage (http://www.toddpacific.com)
- Todd Pacific Shipyards - FAS.org (http://www.fas.org/man/company/shipyard/todd.htm)
- Todd Shipyard's Graving Dock Named to Seven to Save List (http://www.preservenys.org/7S05_toddshipyard.html)
- Todd Shipyard's Graving Dock preservation efforts (http://www.preservenys.org/7S05_toddshipyard_updates.html) - Contains inks to historical background about Todd Shipyards Corporation.

Aircraft

Sikorsky SH-60 Seahawk

SH-60 / HH-60H / MH-60 Seahawk	
U.S. Navy SH-60F with external fuel tank.	
Role	Multimission maritime helicopter
Manufacturer	Sikorsky Aircraft
First flight	12 December 1979
Introduced	1984
Status	Active service
Primary user	United States Navy
Produced	1970s–present
Unit cost	US$28 million (MH-60S)[1]
Developed from	Sikorsky UH-60 Black Hawk
Variants	Sikorsky HH-60 Jayhawk Mitsubishi SH-60

The **Sikorsky SH-60/MH-60 Seahawk** (or **Sea Hawk**) is a twin turboshaft engine, multi-mission United States Navy helicopter based on the airframe of the United States Army UH-60 Black Hawk and a member of the Sikorsky S-70 family. The most significant airframe modification is a hinged tail to reduce its footprint aboard ships.

The U.S. Navy uses the H-60 airframe under the model designations **SH-60B**, **SH-60F**, **HH-60H**, **MH-60R**, and **MH-60S**. Able to deploy aboard any air-capable frigate, destroyer, cruiser, fast combat support ship, amphibious assault ship, or aircraft carrier, the Seahawk can handle anti-submarine warfare (ASW), anti-surface warfare (ASUW), naval special warfare (NSW) insertion, search and rescue (SAR), combat search and rescue (CSAR), vertical replenishment (VERTREP), and medical evacuation (MEDEVAC). All Navy H-60s carry a rescue hoist for SAR/CSAR missions.

Design and development

Origins

During the 1970s the US Navy began looking for new helicopter to replace the Kaman SH-2 Seasprite.[2] The SH-2 Seasprite was used by the Navy as its platform for the Light Airborne Multi-Purpose System (LAMPS) Mark I avionics suite for the maritime warfare and a secondary search and rescue capability. Advances in sensor and avionic technology lead to LAMPS Mk II suite, but the SH-2 was not large enough to carry the Navy's required equipment. In the mid-1970s the Army was evaluating of the Sikorsky YUH-60 and Boeing-Vertol YUH-61 for its Utility Tactical Transport Aircraft System (UTTAS) competition.[3] The Navy based its requirements on the Army's UTTAS specification to decrease costs from commonality.[2] Sikorsky and Boeing-Vertol submitted proposals for Navy versions of their Army UTTAS helicopters in April 1977 for review. The Navy also looked at helicopters being produced by Bell, Kaman, Westland and MBB, but these were too small for the mission. In early 1978 the Navy selected Sikorsky's S-70B design,[2] which was designated "SH-60B Seahawk".

SH-60B Seahawk

The SH-60B maintained 83% commonality with the UH-60A.[4] The main changes made included corrosion protection, more powerful T700 engines, single-stage oleo main landing gear, replacing left side door with fuselage structure, adding two weapon pylons, and shifting the tail landing gear 13 feet (3.96 m) forward to reduce the footprint for shipboard landing. Other changes included larger fuel cells, an electric blade folding system, folding horizontal stabilators for storage, and adding a 25-tube pneumatic sonobuoy launcher on left side.[5] An emergency flotation system was also installed in the stub wing fairings of the main landing gear on both sides of the aircraft.

Five YSH-60B Seahawk LAMPS III prototypes were ordered. The first flight of a YSH-60B occurred on 12 December 1979. The first production version SH-60B achieved its first flight on 11 February 1983. The SH-60B entered operational service in 1984 with first operational deployment in 1985.[3]

The SH-60B LAMPS Mk III is deployed primarily aboard frigates, destroyers, and cruisers. The primary missions of the SH-60B are surface warfare and anti-submarine warfare.

The SH-60B carries a complex system of sensors including a towed Magnetic Anomaly Detector (MAD) and air-launched sonobuoys. Other sensors include the APS-124 search radar, ALQ-142 ESM system and optional nose-mounted forward looking infrared (FLIR) turret. It carries the Mk 46, Mk 50, or Mk 54 torpedo, AGM-114 Hellfire missile, and a single cabin-door-mounted M60D/M240 7.62 mm (0.30 in) machine gun or GAU-16 .50 in (12.7 mm) machine gun.

A standard crew for a SH-60B is one pilot, one ATO/Co-Pilot (Airborne Tactical Officer), and an enlisted aviation warfare systems operator (sensor operator). Operating squadrons are designated Helicopter Anti-Submarine Squadron, Light (HSL).

The SH-60J is a version of the SH-60B for the Japan Maritime Self-Defense Force. The SH-60K is a modified version of the SH-60J. The SH-60J and SH-60K are built under license by Mitsubishi in Japan.[6] [7]

SH-60F Seahawk

After the SH-60B entered service, the Navy began development of the SH-60F variant to replace the SH-3 Sea King.[8] Development of this variant began with the award of a contract to Sikorsky in March 1985. An early SH-60B was modified to serve as a SH-60F prototype. The company was contracted to produce seven SH-60Fs in January 1986 and the first example flew on 19 March 1987.[9]

The SH-60F serves as the carrier battle group's primary anti-submarine warfare (ASW) and search and rescue (SAR) aircraft. It hunts submarines with the AN/AQS-13F dipping sonar, and carries 14 sonobuoys. The SH-60F is unofficially called the "Oceanhawk". The SH-60F can carry the Mk 46, MK 50, or MK 54 torpedo and a choice of cabin-mounted machine guns, including the M60D, M240D, and GAU-16 (50 CAL) for defense. Standard crew complement is one pilot, one copilot, one enlisted tactical sensor operator (TSO), and one enlisted acoustic sensor operator (ASO).

HH-60H Seahawk

The HH-60H was developed beginning in September 1986 with a contract for the first five helicopters. The variant's first flight occurred on 17 August 1988. The HH-60H was developed in conjunction with the US Coast Guard's HH-60J. Deliveries of the HH-60H began in 1989. The variant earned initial operating capability in April 1990.[9] The HH-60H's official DoD and Sikorsky name is *Seahawk*, though it has been called "Rescue Hawk".[10]

Based on the SH-60F, the HH-60H is the primary combat search and rescue (CSAR), naval special warfare (NSW) and anti-surface warfare (ASUW) helicopter. It carries a variety of defensive and offensive sensors making it one of the most survivable helicopters in the world. Sensors include a FLIR turret with laser designator and the Aircraft Survival Equipment (ASE) package including the ALQ-144 Infrared Jammer, AVR-2 Laser Detectors, APR-39(V)2 Radar Detectors, AAR-47 Missile Launch Detectors and ALE-47 chaff/flare dispensers. Additionally, airframe improvements in engine exhaust deflectors provide infrared thermal reduction reducing the threat of heat-seeking missiles. The HH-60H can carry up to four AGM-114 Hellfire missiles on an extended wing using the M299 launcher and a variety of cabin and port window mounted guns including M60D, M240, GAU-16 and GAU-17/A machine guns.

The HH-60H's standard crew is pilot, copilot, an enlisted crew chief, and two door gunners. The HH-60H is operated by Helicopter Antisubmarine (HS) squadrons with a standard dispersal of four F-models and three H-models. Recently HH-60Hs have been used by the Navy, assisting the Army, for MEDEVAC operations in Iraq. For these operations, its crew included pilot, co-pilot, an enlisted crew chief, an enlisted rescue swimmer, and one Corpsmen.

MH-60S "Knighthawk"

The Navy decided to replace its venerable CH-46 Sea Knight helicopters in 1997. After sea demonstrations by a converted UH-60, the Navy awarded production contract for the CH-60S in 1998. The variant first flew in 27 January 2000 and it began flight testing later that year. The CH-60S was redesignated MH-60S in February 2001 to reflect its planned multi-mission use.[11]

The MH-60S is based on the UH-60L and has many naval SH-60 features.[12] It is deployed aboard amphibious assault ships and fast combat supply ships. It has two missions: troop transport and vertical replenishment (VERTREP), but can also perform search and rescue (SAR). The MH-60S has no offensive sensors but can carry the ALQ-144 Infrared Jammer. The MH-60S will, in the near future, deploy with the AQS-20A Mine Detection System and an Airborne Laser Mine Detection System (ALMDS) for identifying submerged objects in coastal waters. The S-model is the first US Navy helicopter to field the glass cockpit whereby the flight data information is relayed to pilots using four digital screens rather than electromechanical gauges and dials. The primary means of defense is with the M60D, M240 or GAU-17/A guns. A "batwing" refit (Armed Helo Kit) based on the Army's UH-60L was developed to accommodate Hellfire, Hydra 70 2.75 inch rockets, or larger guns or cannons.

The MH-60S is unofficially known as the "Knighthawk", reflecting its role as the designated successor of the Sea Knight, though this name was formally disapproved in favor of the "Seahawk" name.[13] [14] A standard crew for the "Knighthawk" is one pilot, one copilot and two others depending on mission. With the retirement of the Sea Knight, the squadron designation of Helicopter Combat Support Squadron (HC) was also retired from the Navy. Operating MH-60S squadrons were re-designated Helicopter Sea Combat (HSC).[15]

Unlike all other Navy H-60s, the MH-60S is not based on the original S-70B/SH-60B platform with its forward-mounted twin tail-gear and single starboard sliding cabin door. Instead, the S-model is a hybrid, featuring the main fuselage of the S-70A/UH-60, with large sliding doors on both sides of the cabin and a single aft-mounted tail wheel; and the engines, drivetrain and rotors of the S-70B/SH-60.[16]

MH-60R Seahawk

The MH-60R was originally referred to as "LAMPS Mark III Block II Upgrade" when it began development in 1993. Two SH-60Bs were converted by Sikorsky for the project. The first modified SH-60 made its maiden flight on 22 December 1999. These conversions, designated YSH-60R, were delivered to NAS Patuxent River in 2001 for flight testing. The production variant was redesignated MH-60R to match its multi-mission capability.[17]

The MH-60R is designed to combine the features of the SH-60B and SH-60F.[18] Its sensors include the ASE package, MTS-FLIR, an advanced airborne fleet data link, and a more advanced airborne active sonar. It does not carry the MAD suite. Pilot instrumentation will be based on the MH-60S's glass cockpit, using several digital monitors instead of the complex array of dials and gauges in Bravo and Foxtrot aircraft. Offensive capabilities are improved by the addition of new Mk-54 air-launched torpedoes and Hellfire missiles. All Helicopter Anti-Submarine (HS) and Helicopter Anti-Submarine Light (HSL) squadrons that receive the Romeo will be redesignated Helicopter Maritime Strike (HSM) squadrons.[15]

Operational history

The Navy received the first production SH-60B in February 1983 and assigned it to squadron HSL-41.[19] [20] The helicopter entered service in 1984,[21] and began its first deployment in 1985.[19]

The SH-60F entered operational service on 22 June 1989 with Helicopter Antisubmarine Squadron 10 (HS-10) at NAS North Island.[11] SH-60F squadrons will shift from the SH-60F to the MH-60S beginning in 2009, they will be redesignated Helicopter Sea Combat (HSC).[22]

The Fleet Replacement Squadron (FRS), HSM-41, received the MH-60R aircraft in December 2005 and has begun training the first set of pilots. In 2007, the R-model successfully underwent final testing for incorporation into the fleet. As of August 2008, the first 11 combat-ready examples equipped HSM-71, a squadron assigned to the USS John C. Stennis (CVN-74). According to Lockheed Martin, "secondary missions include search and rescue, vertical replenishment, naval surface fire support, logistics support, personnel transport, medical evacuation and communications and data relay."[23]

Other and potential users

Spain ordered 12 S-70B Seahawks for its Navy.[24] Spain requested six refurbished SH-60Fs through a Foreign Military Sale in September 2010.[25] [26]

Australia requested approval to buy 24 MH-60Rs through a Foreign Military Sale in July 2010.[27] The MH-60R and the NHIndustries NH90 are being evaluated by the Royal Australian Navy. The helicopter selected is to replace older Seahawks currently in service.[28] [29]

Similarly the Danish Navy (RDN) have the MH-60R on a short list for a requirement of around 12 new naval helicopters, together with the NH90/NFH, H-92, AW159 and AW101. The Request For Proposal was issued on 30 September 2010. A decision is expected in 2011.[30] In November 2010, Denmark requested approval for a possible purchase of 12 MH-60Rs through a Foreign Military Sale.[31] [32]

In July 2009, the Republic of Korea requested eight MH-60S helicopters, 16 GE T700-401C engines, and related sensor systems to be sold in a Foreign Military Sale.[33] In July 2010 Tunisia requested 12 refurbished SH-60Fs through a Foreign Military Sale.[34]

Variants

US versions

- **YSH-60B Seahawk**: Developmental version, led to SH-60B; five built.[35]
- **SH-60B Seahawk**: Anti-submarine warfare helicopter, equipped with an ASP-124 search radar and an ALQ-142 ESM system under the nose, also fitted with a 25 tube sonobuoy launcher on the left side and modified landing gear; 181 built for the US Navy.
- **NSH-60B Seahawk**: Permanently configured for flight testing.[35]
- **CH-60E**: Proposed troop transport version for the US Marine Corps. Not built.[36]
- **SH-60F "Oceanhawk"** Carrier-borne anti-submarine warfare helicopter, equipped with dipping sonar; 81 built for the US Navy.
- **NSH-60F Seahawk**: Modified SH-60F to support the VH-60N Cockpit Upgrade Program.[35]
- **HH-60H "Rescue Hawk"**: Search and rescue helicopter for the US Navy; 42 built.
- **XSH-60J**: Two US built pattern aircraft for Japan.
- **SH-60J**: Anti-submarine warfare helicopter for the Japanese Maritime Self Defense Force.
- **YSH-60R Seahawk**:
- **MH-60R Seahawk**:
- **YCH-60S "Knighthawk"**:
- **MH-60S "Knighthawk"**:

Export versions

- **S-70B Seahawk**: Sikorsky's designation for Seahawk. Designation is often used for exports.
  - S-70B-1 Seahawk: Anti-submarine version for the Spanish Navy. The Seahawk is configured with the LAMPS (Light Airbone Multipurpose System)
  - S-70B-2 Seahawk: Anti-submarine version for the Royal Australian Navy, similar to the SH-60B Seahawk in US Navy operation.
  - S-70B-3 Seahawk: Anti-submarine version for the Japanese Maritime Self Defense Force. Also known as the SH-60J. The JMSDF ordered 101 units, with deliveries starting in 1991.
  - S-70-4 Seahawk: Sikorsky's designation for the SH-60F Oceanhawk.
  - S-70-5: Sikorsky's designation for the HH-60H Rescue Hawk and HH-60J Jayhawk.
  - S-70B-6 Aegean Hawk: the Greek military variant which is a blend of the SH-60B and F models, based on Taiwan's S-70C(M)1/2.
  - S-70B-7 Seahawk: Export version for the Royal Thai Navy.
  - S-70B-28 Seahawk: Export version for Turkey.
- **S-70C**: Designation for civil variants of the H-60.
  - S-70C(M)-1/2 Thunderhawk: Export version for the Republic of China (Taiwan) Navy, equipped with an undernose radar and a dipping sonar.
  - S-70C-2: 24 radar-equipped UH-60 Black Hawks for China, the delivery of the helicopters was halted by an embargo.
  - S-70C-6 Super Blue Hawk: Search and rescue helicopter for Taiwan, equipped with undernose radar, plus provision for four external fuel tanks on two sub wings.
  - S-70C-14: VIP transport version for Brunei; two built.
  - S-70A (N) Naval Hawk: Maritime variant that blends the S-70A Black Hawk and S-70B Seahawk designs.
- **S-70L**: Sikorsky's original designation for the SH-60B Seahawk.

Operators

Australia

- Royal Australian Navy - The Fleet Air Arm (RAN) received 16 S-70B-2 Seahawks,[37] and has 16 S-70Bs in service as of November 2008.[38]
- 816 Squadron RAN

Brazil

- Brazilian Navy - 4 S-70B Seahawks ordered in 2009 and will replace its older helicopters beginning in 2012.[39][40]

Greece

- Hellenic Navy - Received 11 S-70B-6 Aegean Hawks,[41] and has 11 S-70Bs in service as of November 2008.[38]

Japan

- See SH-60J/K

Spain

- Spanish Navy (Armada Española) - received 12 S-70B-1 Seahawks[24] and has 12 S-70Bs in service as of November 2008.[38] A further six were requested in September 2010.[26]

Republic of China (Taiwan)

- Republic of China Navy - received 21 S-70C (10 S-70C(M)-1 and 11 S-70C(M)-2) Thunderhawks,[42] and has 19 S-70Cs in service as of November 2008[38] in 701st and 702nd Helicopter Squadron (Light).[43]

Singapore

- Republic of Singapore Navy - ordered 6 S-70B Seahawks in 2005,[44] with 3 in service in March 2010.[45]

Thailand

- Royal Thai Navy - received 6 S-70B-7 Seahawks,[46] and has 6 MH-60S Seahawks order.[47] It has 6 S-70Bs in use as of November 2008.[38]

Turkey

- Turkish Naval Forces - has received 8 S-70B-28 Seahawks with 17 more on order in 2007.[48] It has 13 S-70Bs in use as of January 2010.[49] It is to have 25 in use by mid-2011.[50]

United States

- United States Navy - 76 MH-60R in service as of December 2010, 75 more on order.[51]

Operational US Navy squadrons

SH-60B

- HSL-37 "Easyriders"
- HSL-40 "Airwolves"
- HSL-42 "Proud Warriors"
- HSL-43 "Battle Cats"
- HSL-44 "Swamp Fox"
- HSL-45 "Wolfpack"
- HSL-46 "Grandmasters"
- HSL-48 "Vipers"
- HSL-49 "Scorpions"
- HSL-51 "Warlords"
- HSL-60 "Jaguars", Navy Reserve

SH-60F/HH-60H

SH-60F Seahawk hoisting up a SAR swim pair

- HS-4 "Black Knights"
- HS-5 "Nightdippers"
- HS-6 "Indians"
- HS-7 "Dusty Dogs"
- HS-10 "Warhawks"
- HS-11 "Dragonslayers"
- HS-14 "Chargers"
- HS-15 "Red Lions"
- HS-75 "Emerald Knights", Navy Reserve, disestablished in 2007.

- HCS-4 "Red Wolves", Navy Reserve, redesignated "HSC-84" in 2006.
- HCS-5 "Firehawks", Navy Reserve, disestablished in 2006
- VX-31 "Dust Devils"

- Note: All HS squadrons will be redesignated HSC, and transition to the MH-60S. HSC-84 operates the HH-60H exclusively.

MH-60R

- HSM-41 "Seahawks"
- HSM-70 "Spartans"
- HSM-71 "Raptors"
- HSM-77 "Saberhawks"

MH-60S

- HSC-2 "Fleet Angels"
- HSC-3 "Merlins"
- HSC-8 "Eightballers"
- HSC-9 "Tridents" redesignated from HS-3 on 1 June 2009
- HSC-12 "Golden Falcons" redesignated from HS-2 on 6 August 2009.[52]
- HSC-21 "Blackjacks"
- HSC-22 "Sea Knights"
- HSC-23 "Wild Cards"
- HSC-25 "Island Knights"
- HSC-26 "Chargers"
- HSC-28 "Dragon Whales"
- HSC-85 "High Rollers", Navy Reserve

Specifications (SH-60B)

Data from Brassey's World Aircraft & Systems Directory,[53] Navy fact file,[13] and Sikorsky S-70B[54] [55]

General characteristics

- **Crew:** 3–4
- **Capacity:** 5 passengers in cabin or slung load of 6,000 lb or internal load of 4,100 lb for B, F and H models and 11 passengers or slung load of 9,000 lb for S
- **Length:** 64 ft 8 in (19.75 m)
- **Rotor diameter:** 53 ft 8 in (16.35 m)
- **Height:** 17 ft 2 in (5.2 m)
- **Disc area:** 2,262 ft² (210 m²)

- **Empty weight:** 15,200 lb (6,895 kg)
- **Loaded weight:** 17,758 lb (8,055 kg) ; for ASW mission
- **Useful load:** 6,684 lb (3,031 kg)
- **Max takeoff weight:** 21,884 lb (9,927 kg)
- **Powerplant:** 2× General Electric T700-GE-401C turboshaft, 1,890 shp (1,410 kW) take-off power each

Performance

- **Never exceed speed:** 180 kn (333 km/h; 207 mph)
- **Maximum speed:** 146 kn (270 km/h; 168 mph)
- **Range:** 450 nmi (518 mi/834 km) at cruise speed
- **Service ceiling:** 12,000 ft (3,580 m)
- **Rate of climb:** 1,650 ft/min (8.38 m/s)

Armament

- Up to three Mark 46 torpedos *or* Mark 50 torpedos,
- AGM-114 Hellfire missile, 4 Hellfire missiles for SH-60B and HH-60H, 8 Hellfire missiles for MH-60S Block III.
- AGM-119 Penguin missile (being phased out),
- M60 machine gun *or*, M240 machine gun *or* GAU-16/A machine gun *or* GAU-17/A Minigun
- Rapid Airborne Mine Clearance System (RAMICS) using Mk 44 Mod 0 30 mm Cannon

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Power Plant and Propulsion

General Electric LM2500

LM2500	
An LM2500 on USS Ford (FFG-54)	
Type	Gas turbine
National origin	United States
Manufacturer	General Electric
First run	1960s
Developed from	General Electric CF6

The **General Electric LM2500** is an industrial and marine gas turbine produced by GE Aviation. The LM2500 is a derivative of the General Electric CF6 aircraft engine.

Current versions of the LM2500 deliver 33,600 shaft horsepower (25.1 MW) with a thermal efficiency of 37 percent at ISO conditions. It has been used in various applications such as in U.S. Navy warships (as well as those belonging to other navies), hydrofoils, hovercraft and fast ferries. As of 2004, more than one thousand LM2500 gas turbines have been in service for more than 29 international navies.[1]

Design and development

A heavy lift lowers the main propulsion module into the hull of USS Bunker Hill (CG-52) during construction at Ingalls Shipbuilding. The module consists of two General Electric LM2500 gas turbine engines and a Westinghouse gear reduction unit.

The LM2500 was first used in US Navy warships in the *Spruance* class of destroyers and the related *Kidd* class, which were constructed from 1970. In this configuration it was rated to 21500 shp (16000 kW). This configuration was subsequently used into the 1980s in the *Oliver Hazard Perry* class frigates, and *Ticonderoga* class cruisers. It was also used by one of People Republic of China's Type 052 Luhu Class Missile Destroyer (Harbin 112) acquired before the embargo.

The LM2500 was uprated to 26500 shp (19800 kW) for the *Arleigh Burke* class destroyers, which were initiated in the 1980s and started to see service in the early 1990s, and the T-AOE-6 class of fast combat tanker.

In 2001 the LM2500 (20 MW) was installed in a sound-proof capsule in the SA Navy Valour class (Meko A-200 SAN) frigates as part of a CODAG propulsion system with two MTU 16V 1163 TB93 Propulsion Diesels.

The current generation was uprated in the late 1990s to over 30000 shp (22000 kW).

Many of the military LM2500 installations place the engine inside a metal container of the same dimensions as a standard 40-foot (12 m) intermodal shipping container - 8 feet (2.4 m) wide, 8.5 feet (2.6 m) tall, and 40 feet (12 m) long. The containerized LM2500s may be designed for easy removal from their ships if the air intake ducting is shaped appropriately.

The LM2500+ is an evolution of the LM2500, delivering up to 40200 shp (30000 kW) or 28.6 MW of electric energy when combined with an electrical generator. Two of such turbo-generators have been installed in the superstructure near the funnel of *Queen Mary 2*, the world's largest transatlantic ocean liner, for additional electric energy when the ship's four diesel-generators are working at maximum capacity or fail. Celebrity Cruises uses two LM2500+ engines in their *Millennium*-class ships in a COGAS cycle.

The LM2500 is license-built in Japan by Ishikawajima-Harima and in Italy by Avio.

The LM2500/LM2500+ can often be found as turbine part of CODAG or CODOG propulsion systems or in pairs as powerplants for COGAG systems.

Applications

- Arleigh Burke class destroyer
- Independence class littoral combat ship
- Kidd class destroyer
- Oliver Hazard Perry class frigate
- Spruance class destroyer
- Shivalik class frigate
- Ticonderoga class cruiser
- Type 052 destroyer
- Valour class frigate
- Sachsen class frigate
- Brandenburg class frigate
- Bremen class frigate

- FREMM multipurpose frigate
- Horizon class frigate
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- Anzac class frigate
- Sa'ar 5 class corvette

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Azimuth thruster

An **azimuth thruster** is a configuration of ship propellers placed in pods that can be rotated in any horizontal direction, making a rudder unnecessary. These give ships better maneuverability than a fixed propeller and rudder system.

Types of azimuth thrusters

There are two major variants, based on the location of the motor:

1. Mechanical transmission, where a motor inside the ship is connected to the pod by gearing. The motor may be diesel or diesel-electric. Depending on the shaft arrangement the mechanical azimuth thruster are divided into L-drive and Z-drive. An L-drive thruster has a vertical input shaft and a horizontal output shaft with one right-angle gear. A Z-drive thruster has an horizontal input shaft, vertical shaft in the rotating column and a horizontal output shaft with two right-angle gears.
2. Electrical transmission, where an electric motor is in the pod itself, connected directly to the propeller without gears. The electricity is produced by an onboard engine, usually diesel or gas turbine. Invented in 1955 by Mr. F.W. Pleuger and Mr. F. Busmann (*Pleuger Unterwasserpumpen GmbH*), ABB *Azipod* was the first product using this technology.

Mechanical azimuth thrusters can be fixed installed, retractable and underwater-mountable. They may have fixed pitch propellers (FPP) or controllable pitch propellers (CPP). Fixed installed thrusters are used for tugs, ferries and supply-boats. Retractable thrusters are used as auxiliary propulsion for dynamically positioned (DP) vessels and take-home propulsion for military vessels. Underwater-mountable thrusters are used as dynamic positioning propulsion for very large vessels such as semi-submersible drilling rigs.

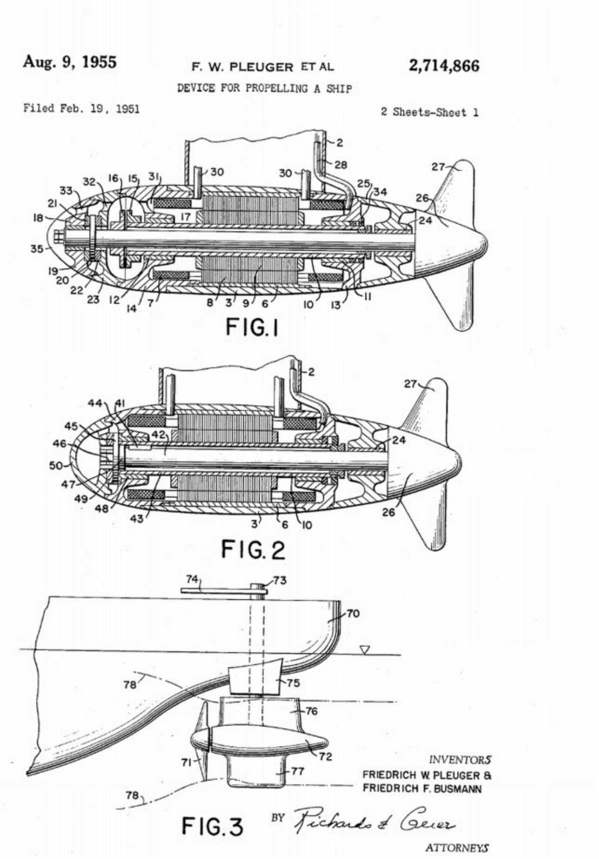
Advantages

Primary advantages are electrical efficiency, better use of ship space, and lower maintenance costs. Ships with azimuth thrusters do not need tugs to dock, though they still require tugs to maneuver in difficult places.

History

The first azimuth thrusters, using the mechanical Z-drive transmission, were built by Hollming in Finland in the 1960s under the *Aquamaster* brand name.[1] The business was later sold to Rolls-Royce, after the merger of Finnish shipyards into Finnyards.

Later, subsidiaries of ABB, also based in Finland, developed the *Azipod* thruster, with the motor located in the pod itself. This kind of propulsion was first patented in 1955 by Pleuger of Germany.



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Controllable pitch propeller

A **controllable pitch propeller** (CPP) or **variable pitch propeller** is a special type of propeller with blades that can be rotated around their long axis to change their pitch. If the pitch can be set to negative values, the **reversible propeller** can also create reverse thrust for braking or going backwards without the need of changing the direction of shaft revolutions.

Aircraft

The earliest known attempt towards creating a variable-pitch propeller of any type for an aircraft, though only adjustable on the ground before or after flight, was on the *IdFlieg*-numbered "R.30/16" example of the Zeppelin-Staaken R.VI four-engined World War I-era *Riesenflugzeug* heavy bomber in 1918.

The French aircraft firm Levasseur displayed a variable pitch propeller at the 1921 Paris Airshow which they claimed had been tested by the French government in a ten hour run and could change pitch at any engine rpm. But nothing was ever heard anymore about the Levasseur development after 1921. [1]

The first practical controllable pitch propeller for aircraft was introduced in 1932. [2]

Such propellers are used in propeller aircraft to adapt the propeller to different thrust levels and air speeds so that the propeller blades don't stall, hence degrading the propulsion system's efficiency. Especially for cruising, the engine can operate in its most economical range of rotational speeds. With the exception of going into reverse for braking after touch-down, the pitch is usually controlled automatically without the pilot's intervention. A propeller with a controller that adjusts the blades' pitch so that the rotational speed always stays the same is called a *constant speed propeller*.

The most common type of controllable pitch propeller is hydraulically actuated; it was originally developed by Frank W. Caldwell of the Hamilton Standard Division of the United Aircraft Company. This design led to the award of the Collier Trophy of 1933. [3]

A propeller with controllable pitch can have a nearly constant efficiency over a range of airspeeds.[3]

Ships

A ship's controllable pitch propeller

Controllable pitch propellers (CPP) for marine propulsion systems have been designed to give the highest propulsive efficiency over a broad range of speeds and load conditions. When the vessel is fully loaded with cargo the propulsion required at a given ship speed is much higher than when the vessel is empty. By adjusting the blade pitch, the optimum efficiency can be obtained and fuel can be saved. Also, the controllable pitch propeller has a "vane"-stance, which is useful with combined sailing / motor vessels as this stance gives the least water resistance when not using the propeller (e.g. when the sails are used instead).

A fixed pitch propeller (FPP) is more efficient than a controllable pitch propeller under a *specific* rotational speed and load condition. At that particular rotational speed and load, a FPP can transmit power more efficiently than a CPP. At any other rotational speed, or any other vessel loading, the FPP will not be more efficient, either being over pitched or under pitched. A correctly sized controllable pitch propeller can be efficient for a wide range of rotational speeds, since pitch can be adjusted to absorb all the power that the engine is capable of producing at nearly any rotational speed.

The CPP also improves maneuverability of a vessel. When maneuvering the vessel the advantage of the CPP is the fast change of propulsion direction. The direction of thrust can be changed without slowing down the propeller and depending on the size of the CPP can be changed in approximately 15 to 40 seconds. The increased maneuverability can eliminate the need for docking tugs while berthing.

A reversing gear or a reversible engine is not necessary for ships utilizing CPP, saving money to install and service these components. Depending on the main engine rotational speed and the size of the CPP, a reduction gear may still be required. A CPP does require a hydraulic system to control the position of the blades. A CPP does not produce more or less wear or stress on the propeller shaft or propulsion engine than an FPP. Therefore this will not be an argument to choose between an FPP or a CPP.

Large vessels that make long trips at a constant service speed, for example crude oil tankers or the largest container ships, do not utilize a CPP, since the amount of power generated exceeds the current CPP design capabilities. A CPP is usually found on harbor or ocean-going tugs, dredgers, cruise ships, ferries, cargo vessels and larger fishing vessels that sail to ports with limited or no tug assistance.

Current CPP designs can tolerate a maximum output of 44000 kW (60,000 hp).

References

[1] "Pierre Levasseur (http://www.flightglobal.com/pdfarchive/view/1921/1921 - 0761.html) *FlIGHT*, November 17th 1921, see last paragraph on page 761

[2] "Gear Shift For Airplanes Seen In Controllable Prop" (http://books.google.com/books?id=fvEDAAAAMBAJ&pg=PA951&dq=popular+mechanics+1932+protecting+the+world's&hl=en&ei=u6EVTcKMOsiDngev593NDg&sa=X&oi=book_result&ct=result&resnum=1&ved=0CCMQ6AEwAA#v=onepage&q&f=true) *Popular Mechanics, December 1932*

[3] Lutze. Level flight performance (http://www.aoe.vt.edu/~lutze/AOE3104/levelflightperf.pdf) page 8 *The Department of Aerospace and Ocean Engineering, Virginia Tech*. Accessed: 6 January 2011.

External links

- 1941 Cutaway Drawing of Hydromatic Variable Pitch Propeller Operation (http://books.google.com/books?id=nCcDAAAAMBAJ&pg=PA105&dq=popular+science+September+1941&hl=en&ei=v5eRTIDkH42lnQfu4rSDBw&sa=X&oi=book_result&ct=result&resnum=2&ved=0CDIQ6AEwAQ#v=onepage&q=popular science September 1941&f=true) on B-24 bomber

Stabilizer (ship)

This article refers to the nautical term. For other uses, see stabilizer.

Ship **stabilizers** are fins mounted beneath the waterline and emerging laterally. In contemporary vessels, they may be gyroscopically controlled active fins, which have the capacity to change their angle of attack to counteract roll caused by wind or waves acting on the ship.

The bilge keel is an early 20th century predecessor. Although not as effective at reducing roll, bilge keels are cheaper, easier to install, and do not require dedicated internal space inside the hull.

The first mention of automatic stabilizers for ships, was is in 1932, by an engineer working for General Electric. [1]

Reference

[1] "Fins Purposed For Big Liners To Prevent Rolling" (http://books.google.com/books?id=7-EDAAAAMBAJ&pg=PA251&dq=popular+mechanics+1932+the+president+of+a+big&hl=en&ei=JIgVTcvHIM2AnQf50_3fDQ&sa=X&oi=book_result&ct=result&resnum=1&ved=0CCYQ6AEwAA#v=onepage&q&f=true) *Popular Mechanics, August 1932*

Armament

Otobreda 76 mm

Otobreda 76 mm	
The Otobreda 76mm *Super Rapid* as mounted in a stealth cupola (to reduce Radar cross-section) onboard the Norwegian *Fridtjof Nansen*.	
Type	Naval gun
Place of origin	🇮🇹 Italy
Service history	
In service	1964 - present
Used by	See *users*
Production history	
Designer	Oto Melara
Designed	Compact: 1963 Super Rapid: 1985
Manufacturer	Oto Melara (1963–2001) OtoBreda (2001 onwards)
Produced	Compact: 1964 Super Rapid: 1988
Variants	See *variants*
Specifications	
Weight	Empty: 7.5 tonnes (17000 lb)
Barrel length	62 caliber: 4724.4 mm (186.00 in)
Shell	76×900mmR (complete round) 12.34 kilograms (27.2 lb)
Caliber	76.2 mm (3.00 in)
Elevation	-15°/+85° speed:35°/s (acceleration: 72°/s²)
Traverse	360° speed: 60°/s (acceleration: 72°/s²)
Rate of fire	*Compact*: 85 round/min *Super Rapid*: 120 round/min
Muzzle velocity	925 m/s (3030 ft/s)
Maximum range	HE round fired at 45°: *Compact*: 20000 m (22000 yd) *Super Rapid*: 30000 m (33000 yd)
Feed system	Magazine capacity: 80 ready rounds on *Compact* gun mount 85 ready rounds on *Super Rapid* gun mount

The **Otobreda 76 mm** gun is a naval artillery piece built by the Italian defence conglomerate of Otobreda, developed originally from the Oto Melara 76/62mm Allargato, which was bigger, heavier and had a slower rate of fire. A vehicle-mounted version known as the Otomatic was built for the self-propelled anti-aircraft gun role, although this was not put into production.

The gun is capable of very high rates of fire, making it suitable for short-range anti-missile point defence. Its calibre also gives it abilities for anti-aircraft, anti-surface and ground shelling. Specialised ammunition is available for armour piercing, incendiary and directed fragmentation. A new stealth cupola has been designed in recent years.

The system is compact enough to be installed on relatively small warships, like corvettes, avisos (a vessel somewhere between a corvette and a patrol boat), or patrol boats. It has been widely exported and is in use with 53 navies.

It has recently been favoured over the French 100 mm naval gun for the new Horizon CNGF frigates.

On 27 September 2006 Iran announced it has started mass production of a marine artillery gun, named the Fajr-27, which is a reverse-engineered Oto Melara 76 mm gun.[1]

Other specifications

- **Cooling:** sea water—fresh water for flushing
- **Electrical Power supply**
  - 440 V, 3-phase, 60 Hz, main circuit;
  - 115 V, 1-phase, 400 Hz, servo and synchro network

Variants

- **76/62 Super Rapid** - with increased rate of fire of 120 rounds per minute and increased range of 30 km.

Users

Platforms using the Oto-Melara 76 mm include:

Asia

Bangladesh

- Ulsan class frigate

Indonesia

- Van Speijk class frigate
- Sigma class corvette

India

- Godavari class frigate
- Brahmaputra class frigate
- Shivalik class frigate
- kora class corvette
- Kamorta class corvette
- Veer class corvette

Iran

- Kaman class missile boat

Israel

- Saar 3 class missile boat

- Saar 4 class missile boat
- Saar 4.5 class missile boat

Japan

- Hatsuyuki class destroyer
- Asagiri class destroyer
- Murasame class destroyer
- Ishikari class destroyer escort
- Yubari class destroyer escort
- Abukuma class destroyer escort
- Hayabusa class patrol boat

South Korea

- Ulsan class frigate
- Pohang class corvette
- Donghae class corvette
- Gumdoksuri class patrol vessel

Myanmar

- Aung Zay Ya class frigate
- Anawyatha class corvette

Malaysia

- Laksamana class corvette
- Kedah Class Offshore Patrol Vessel

Philippines

- Jacinto class corvette

Singapore

Republic of Singapore Navy

- Endurance class LST
- Formidable class frigate
- Victory class corvette
- Fearless class patrol vessel

Sri Lanka

- Nandimithra Class Saar 4 class fast missile vessel

Thailand

- Pattani class offshore patrol vessel
- Ratanakosin class corvette
- Ratcharit missile boat
- Chuburi patrol boats
- Tapi class large patrol corvette
- Khamronsin class corvette

Republic of China (Taiwan)

- Cheng Kung class frigate
- *Kang Ding* class frigate

Africa

Egypt

- Ambassador MK III Missile Boat
- *Descubierta* class corvette - Spanish built
- Oliver Hazard Perry class frigate
- Ramadan class missile boat
- Type-148 Tiger class fast attack missile boat

Morocco

- *Descubierta* class corvette - Spanish built
- Floreal class frigate
- OPV70 class patrol vessel

South Africa

- *Warrior* class - modified Sa'ar 4 class missile boat with two guns
- Valour class frigate - German built MEKO design

Tunisia

- Type 143 Albatros class fast attack craft

Europe

Belgium

- Karel Doorman class frigate

Denmark

- Flyvefisken class patrol vessel
- Thetis class patrol frigates
- Ivar Huitfeldt class frigate (In service from 2012)
- Knud Rasmussen class patrol vessel

France

- FREMM multipurpose frigate
- Horizon Common New Generation Frigate

Germany

- Brandenburg class frigate - MEKO design
- Bremen class frigate - MEKO design
- Sachsen class frigate - MEKO design
- Braunschweig class corvette - MEKO design
- Gepard class fast attack craft

Greece

- Elli class frigate
- FACM Class La Combattante III
- FACM Class La Combattante IIIb
- FACM Class La Combattante IIa

- Osprey 55 class gunboat
- HSY-55 class gunboat
- Osprey HSY-56A class gunboat

OTO-Melara 76 mm gun onboard the Sachsen class frigate - F221 *Hessen*

- Roussen Class (62m Super-Vita design)
- Jason Class (LST)

Ireland

- Peacock class patrol vessels
- Róisín class Offshore Patrol Vessels

Italy

- Audace class destroyer
- Durand de La Penne class destroyer
- San Giorgio class amphibious transport dock
- Cassiopea class patrol vessel
- Minerva class corvette
- FREMM multipurpose frigate
- Horizon Common New Generation Frigate
- Cavour

Netherlands

- Karel Doorman class frigate
- Holland class offshore patrol vessels

Norway

- Fridtjof Nansen class frigate
- Skjold class patrol boat

Poland

- Oliver Hazard Perry class frigate

Portugal

- Bartolomeu Dias class (former Dutch Karel Doorman class)

Romania

- Regele Ferdinand frigate
- Regina Maria frigate

Spain

- Santa Maria class frigate
- Descubierta class patrol vessel
- Buque de Accion Maritima (BAM) Class

Turkey

- Doğan class fast attack craft
- Kılıç class fast attack craft
- Kılıç-II class fast attack craft
- Yıldız fast attack craft
- G class frigate
- Milgem class corvette

North America

Canada

- Iroquois class destroyer after TRUMP modifications (Canada)

United States

- *Famous*-class medium endurance cutter (USCG)
- *Hamilton*-class high endurance cutter (USCG)
- *Oliver Hazard Perry*–class frigate (USN)
- *Pegasus*-class hydrofoil (now de-commissioned) (USN)

Mexico

- Oaxaca class Offshore Patrol Vessel(Mexican Navy)

The Mk 75 in use aboard USCGC *Gallatin*, 2005.

Oceania

Australia

- Adelaide class frigate

South America

Argentina

- Espora class frigate - license built MEKO 140 design

Chile

- Karel Doorman class frigate¨
- Type 22 Batch II frigate "Almirante Williams"
- Saar 4 class missile boat
- Type 148 missile boat

Ecuador

- Quito class missile boat (Ecuador)

Peru

- PR-72P class corvette (Peru)

Colombia

- Almirante Padilla class frigate

References

Notes

[1] http://www.middle-east-online.com/english/?id=17626

External links

- Oto Melara products: medium calibres (http://www.otobreda.it/products/products.asp?id=prod_naval_medium)
- Italian 76 mm/62 (3") Compact, SR and USA 76 mm/62 (3") Mark 75 (http://www.navweaps.com/Weapons/WNUS_3-62_mk75.htm) at NavWeaps

M2 Browning machine gun

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This article is about the .50 caliber M2 machine gun. For the .30-06 M2 machine gun, see M1919 Browning machine gun. Browning Machine Gun, Cal. .50, M2, HB M2HB heavy machine gun Type Heavy machine gun Place of origin United StatesUnited States Service history In service M2HB from 1933–present Used by See #UsersUsers Wars World War IIKorean WarFirst Indochina WarSuez CrisisVietnam WarCambodian Civil WarCambodian-Vietnamese WarFalklands WarSouth African Border WarUnited States invasion of PanamaGulf WarSomali Civil WarOperation Medak PocketWar in Afghanistan (2001–present)Afghanistan and Iraq WarIraq wars Production history Designed 1918 M2 .50 Caliber Machine Gun Manufacturer Current: General Dynamics, Fabrique Nationale, US Ordnance, and Manroy Engineering Former: Sabre Defence Industries, Colt's Patent Fire Arms Company, High Standard Company, Savage Arms Corporation, Buffalo Arms Corporation, General Motors Corporation (Frigidaire, AC Spark Plug, Saginaw Steering, and Brown-Lipe-Chappin Divisions), Kelsey Hayes Wheel Company, Springfield Armory, Wayne Pump Company, ERMCO, and Ramo Manufacturing Produced 1921–present (M2HB) Number built 3 million "Report: Profiling the Small Arms Industry - World Policy Institute - Research Project". World Policy Institute. November 2000. . Retrieved 2010-07-15. Specifications Weight 38 kilogramkg (83.78 pound (mass)lb) 58 kilogramkg (127.87 pound (mass)lb) with tripod (weapon)tripod and T&E Length 1656 millimetremm (65.2 inchin) Gun barrelBarrel length 1143 mm (45.0 in) Cartridge (firearms)Cartridge.50 BMG.50 BMG (12.7x99mm NATO)Firearm actionActionRecoil operationShort recoil-operatedRate of fireRate of fire 485-635 rounds/min (M2HB) M2HB-QCB 750–850 rounds/min (AN/M2) 1,200 rounds/min (AN/M3) Muzzle velocityMuzzle velocity 2,910 feet/sec (887.1 m/s) for M33 ball Effective range 2,000 m (2,187 yds) Maximum range 6,770 m (7,400 yd) Feed system Belt (firearm)Belt-fed (M2 or M9 links) The M2 Machine Gun, Browning .50 Caliber Machine Gun, is a heavy machine gun designed towards the end of World War I by John Browning. It is very similar in design to John Browning's earlier M1919 Browning machine gun, which was chambered for the .30-06 Springfield.30-06 cartridge. The M2 uses the larger and more powerful .50 BMG cartridge, which was named for the gun itself (BMG standing for Browning Machine Gun). The M2 has been referred to as "Ma Deuce",Rottman, Gordon (2008). The Us Army in the Vietnam War 1965-73. Reading: Osprey Publishing. p. 56. ISBN 1846032393. or "the fifty" in reference to its caliber. The design has had many specific designations; the official designation for the current infantry type is Browning Machine Gun, Cal. .50, M2, HB, Flexible. It is effective against infantry, unarmored or lightly armored vehicles and boats, light fortifications, and low-flying aircraft.The Browning .50 caliber machine gun has been used extensively as a vehicle weapon and for aircraft armament by the United States from the 1920s to the present day. It was heavily used during World War II, the Korean War, the Vietnam War, as well as during operations in Iraq and Afghanistan in the 2000s. It is the primary heavy machine gun of NATO countries, and has been used by many other countries as well. With the exception of the .45 ACP M1911 pistol, the M2 has been in use longer than any other small arm in U.S. inventory. The M2HB is currently manufactured in the United States by General Dynamicshttp://www.defense.gov/contracts/contract.aspx?contractid=4360 and U.S. Ordnance, Inc.US Ordnance http://www.defense.gov/contracts/contract.aspx?contractid=4072for use by the United States government, and for US Foreign Allies via FMS sales. FN has manufactured the M2 machine gun since the 1930s.http://www.fnherstal.com/index.php?id=655 US Ordnance developed their M2 Quick Change Barrel system after years of experience manufacturing machine guns for the U.S. Department of Defense and U.S. Foreign Allies.http://usord.com/products_m2hb.phpHistoryA variant without a water jacket, but with a thicker-walled, air-cooled Gun barrelbarrel superseded the M2 (air-cooled barrels had already been used on variants for use on aircraft, but these quickly overheated in ground use). This new variant was then designated the M2 HB (HB for Heavy Barrel). The added mass and surface area of the new barrel compensated, somewhat, for the loss of water-cooling, while reducing bulk and weight (the M2 weighed 121 lb (55 kg), with water, whereas the M2 HB weighs 84 lb). Due to the long procedure for changing the barrel, an improved system was developed called QCB (quick change barrel). A lightweight version, weighing a mere 60 lb (27 kg) was also developed. "Skylighters, The Web Site of the 225th AAA Searchlight Battalion: AAA Weapons in Focus - The M2 .50-Caliber Machine Gun". Skylighters.org. . Retrieved 2008-09-08.Design details The Browning M2 is an air-cooled, Belt (firearm)belt-fed machine gun. The M2 fires from a closed bolt, operated on the short recoil principle. The M2 fires the .50 BMG cartridge, which offers long range, accuracy and good stopping power. The M2 is a scaled-up version of John Browning's M1917 Browning machine gunM1917 .30 caliber machine gun (even using the same timing gauges). FeaturesTwin M2HB .50 caliber machine gun during a Pre-aimed Calibration Fire (PACFIRE) exercise.The M2 has varying cyclic rates of fire, depending upon the model. The M2HB (heavy barrel) air-cooled ground gun has a cyclic rate of 450-575 rounds per minute.Dunlap, Roy F., Ordnance Went Up Front, Samworth Press (1948), pp. 310-311: the official rate during WWII was 450–575 rpm, but it was extremely rare to encounter a M2HB that exceeded 550 rpm. The early M2 water-cooled AA guns had a cyclic rate of around 450–600 rpm.DiGiulian, Tony, USA 0.50"/90 (12.7 mm) M2 Browning Machine Gun (2007) Article The AN/M2 aircraft gun has a cyclic rate of 750–850 rpm; this increases to 1,200 rpm or more for AN/M3 aircraft guns fitted with electric or mechanical feed boost mechanisms.Dunlap, Roy F., Ordnance Went Up Front, Samworth Press (1948), pp. 310-311 These maximum rates of fire are generally not achieved in use, as sustained fire at that rate will wear out the bore within a few thousand rounds, necessitating replacement. For the M2HB, slow fire is less than 40 rounds per minute and rapid fire more than 40 rounds per minute.http://m2hb.net/manuals/fm23_65.pdfThe M2 has a maximum range of 7.4 kilometers (4.55 miles), with a maximum effective range of 1.8 kilometers (1.2 miles) when fired from the M3 tripod. In its ground-portable, crew-served role as the M2HB, the gun itself weighs in at a hefty 84 pounds (38 kg), and the assembled M3 tripod another 44 pounds (20 kg). In this configuration, the V-shaped "butterfly" trigger is located at the very rear of the weapon, with a "spade handle" hand-grip on either side of it and the bolt release the center. The spade handles are gripped and the butterfly trigger is depressed with one or both thumbs. Recently new rear buffer assemblies have used squeeze triggers mounted to the hand grips, doing away with the butterfly triggers. A U.S. Marine mans a .50 caliber machine gun as part of a security force during an exerciseWhen the bolt release is locked down by the bolt latch release lock on the buffer tube sleeve, the gun functions in fully automatic mode. Conversely, the bolt release can be unlocked into the up position resulting in single-shot firing (the gunner must press the bolt latch release to send the bolt forward). Unlike virtually all other modern machine guns, it has no safety (although a sliding safety switch has recently been fielded to USMC armorers for installation on their weapons). Troops in the field have been known to add an improvised safety measure against accidental firing by slipping an expended shell casing under the butterfly trigger. Crew Served Weapons lesson planBecause the M2 was intentionally designed to be fit into many configurations, it can be adapted to feed from the left or right side of the weapon by exchanging the belt-holding pawls, and the front and rear cartridge stops (3-piece set to include link stripper), then reversing the bolt switch. The operator must also convert the top-cover belt feed slide assembly from left to right hand feed as well as the spring and plunger in the feed arm. This will take a well trained individual less than 2 minutes to perform. The charging assembly may be changed from left to right hand charge. A right hand charging handle spring, lock wire and a little know how are all that are required to accomplish this. The weapon can be battle ready and easily interchanged if the weapon is fitted with a retracting slide assembly on both sides of the weapon system to eliminate the need to have the weapon taken in to accomplish this task. Ammunition There are several different types of ammunition used in the M2HB and AN aircraft guns. From World War II through the Vietnam War, the big Browning was used with standard ball, armor-piercing (AP), armor-piercing incendiary (API), and armor-piercing incendiary tracer (APIT) rounds. All .50 ammunition designated "armor-piercing" was required to completely perforate 0.875" (22.2 mm) of hardened steel armor plate at a distance of 100 yards (91 m), and 0.75" (19 mm) at 547 yards (500 m).Barnes, Frank C., Cartridges of the World, U.S. Army .50 BMG Cartridge Specifications, DBI Books (1989), ISBN 0873490339, p.432 The API and APIT rounds left a flash, report, and smoke on contact, useful in detecting strikes on enemy targets; they were primarily intended to incapacitate thin-skinned and lightly armored vehicles and aircraft, while igniting their fuel tanks.Dunlap, Roy F., Ordnance Went Up Front, Samworth Press (1948), pp. 311-312Current ammunition types include: M33 Ball (706.7 grain) for personnel and light material targets, M17 tracer, M8 API (622.5 grain), M20 API-T (619 grain), and M962 SLAP-T. The latter ammunition along with the M903 SLAP (Saboted Light Armor Penetrator) round can perforate 1.34 in (34 mm) of HHA (high hard armor, or face-hardened steel plate) at 500 meters, 0.91 in (23 mm) at 1,200 meters, and 0.75 in (19 mm) at 1,500 meters. This is achieved by using a 0.3-inch-diameter (7.6 mm) tungsten penetrator. The SLAP-T adds a tracer charge to the base of the ammunition. This ammunition was type classified in 1993. M903 Caliber .50 Saboted Light Armor Penetrator (SLAP), M962 Saboted Light Armor, GlobalSecurity.org Caliber .50 Cartridges, GlobalSecurity.orgWhen firing blanks, a large blank-firing adapter (BFA) must be used to keep the gas pressure high enough to allow the action to cycle. The adapter is very distinctive, attaching to the muzzle with three rods extending back to the base. The BFA can often be seen on M2s during peacetime operations. DeploymentAn M2 fired from a rigid-hulled inflatable boat.The M2 .50 Browning machine gun has been used for various roles: A medium infantry support weapon As an anti-aircraft (AA) gun in some ships; up to six M2 guns could be mounted on the same turret. As an anti-aircraft gun on the ground. The original water-cooled version of the M2 was used on a tall AA tripod or vehicle-mounted anti-aircraft weapon on a sturdy pedestal mount. In later variants, twin and quadruple M2HB Brownings were used, such as the M45 Quadmount used on the US M3 Half-trackM16 half-track carrier. Twin or quad-mount .50 M2 guns normally used alternating left-hand and right-hand feed. Primary or secondary weapon on an armored fighting vehicle. Primary or secondary weapon on a naval patrol boat. Spotting for the primary weapon on some armored fighting vehicles. Secondary weapon for anti-boat defense on large naval vessels (corvettes, frigates, destroyers, cruisers, etc.). Coaxial gun or independent mounting in some tanks. Fixed-mounted primary armament in World War II-era U.S. aircraft such as the P-47 Thunderbolt, P-51 Mustang, and the Korean-era U.S. F-86 Sabre. Fixed or flexible-mounted defensive armament in World War II-era bombers such as the B-17 Flying Fortress, and B-24 Liberator. United StatesA U.S. soldier in Normandy stands guard with the M2HB installed on a dual-purpose mounting.At the outbreak of the Second World War the United States had versions of the M2 in service as fixed aircraft guns, anti-aircraft defensive guns (on aircraft, ships, or boats), infantry (tripod-mounted) guns, and as dual purpose anti-aircraft and anti-vehicular weapons on vehicles.Dunlap, Roy F., Ordnance Went Up Front, Samworth Press (1948), p. 225George, John B., Shots Fired In Anger, NRA Press (1981), p. 404: By World War II, the M2HB had been designated as a dual-purpose anti-aircraft and anti-vehicular weapon for motorized, armored, and infantry divisions; the designation "anti-vehicular" included thin-skinned and lightly armored vehicles, as it was already recognized by 1940 that the .50 M2 AP round would not be useful against modern medium or heavy tanks.The .50 AN/M2 light-barrel aircraft Browning used in planes had a rate of fire of approximately 800 rounds per minute, and was used singly or in groups of up to eight guns for aircraft ranging from the P-47 Thunderbolt to the B-25 Mitchell bomber. In the dual-purpose vehicle mount, the M2HB (heavy barrel) proved extremely effective in U.S. service: the Browning's .50 caliber AP and API rounds could easily penetrate the engine block or fuel tanks of a German Bf 109 fighter attacking at low altitude,Bird, James, Recollections of James R. Bird, A Battery, 160th F.A., 45th Inf. Div., Article or perforate the hull plates and fuel tanks of a German SdKfz 251half-track or Leichter Panzerspahwagenlight armored car.Green, Michael, and Green, Gladys, Weapons of Patton's Armies, Zenith Imprint Press (2000), ISBN 0760308217, 9780760308219, p. 34Bishop, Chris, The Encyclopedia of Weapons of World War II, Sterling Publishing Company, Inc. (2002), ISBN 1586637622, 9781586637620, p. 86 While the dual-purpose mounting was undeniably useful, it did normally require the operator to stand when using the M2 in a ground role, exposing him to return fire.Green, Michael, and Green, Gladys, Weapons of Patton's Armies, Zenith Imprint Press (2000), ISBN 0760308217, 9780760308219, pp. 32-34 Units in the field often modified the mountings on their vehicles, especially tanks and tank destroyers, to provide more operator protection in the anti-vehicular and anti-personnel role.Yeide, 2004. p. 185 The weapon was particularly hated by the Germans, whose attacks against otherwise helpless stalled motor convoys were frequently broken up by .50 caliber machine gun fire.Burgett, Donald, Seven Roads To Hell, Dell Publishing (1999), ISBN 0440236274, p. 129Jarymowycz, Roman J., Tank Tactics: From Normandy to Lorraine, Lynne Rienner Publishers (2001), ISBN 1555879500, 9781555879501, p. 212Besides vehicle-mounted weapons, the heavy weapons companies in a WWII Army infantry battalion or regiment were each issued one M2 Browning with tripod (ground) mount.Rush, Robert S., GI: The US Infantryman in World War II, Osprey Publishing Ltd. (2003), ISBN 1841767395, p. 33 Mounted on a heavily sandbagged tripod, the M2HB proved very useful in either a defensive role or to interdict or block road intersections from use by German infantry and motorized forces.Dunlap, Roy F., Ordnance Went Up Front, Samworth Press (1948), pp. 225, 311-312 The hammering of a heavy Browning could usually be relied upon to put a German infantry company face-down in the dirt.Henry, Mark R., The US Army in World War II (2): The Mediterranean, Osprey Publishing (2000), ISBN 1841760854, 9781841760858, p. 20 There are numerous instances of the M2 Browning being used against enemy personnel, particularly infantry assaultsAbramski, Anthony V. (Pfc.), Eyewitness Account of Pfc. Anthony V. Abramski, Citation In Support Of Congressional Medal of Honor Award to 2nd Lt. Audie Murphy at Holtzwihr, France, 26 January 1945 or for interdiction or elimination of enemy artillery observers or snipers at distances too great for ordinary infantry weapons.Wolfe, Clarence B., I Kept My Word, AuthorHouse Press (2006), ISBN 1425969518, 9781425969516, p. 68The United States Army in World War II, Ch. XXI: Artillery & Armored Units in the ETO, Washington, D.C.: Historical Division, U.S. Army (1993), p. 645Jarymowycz, Roman J., Tank Tactics: From Normandy to Lorraine, Lynne Rienner Publishers (2001), ISBN 1555879500, 9781555879501, p. 212: The M2HB fitted to tanks and M3 half-tracks was frequently employed against German rearguard forces including snipers and anti-tank teams, often firing into locations merely suspected of hiding such forces (so-called speculative fire).M16 .50 AA Quad aka the 'Meat Chopper'A quadruple mount of four .50 M2HB guns with a single gunner situated behind an armored housing was used by U.S. AA battalions in either a towed trailer or mounted in a half-track carrier (M16 AA half-track). With 200 rounds per gun in a powered tracking mount, the guns proved very effective against low-flying aircraft. Towards the end of the war, as Luftwaffe attacks became less frequent, the quad .50 (nicknamed the Meat Chopper) was increasingly used in an anti-personnel role, similarly to the more powerful German 20mm 2 cm FlaK 30#2 cm Flakvierling 38Flakvierling. Snipers firing from trees were engaged by the quad gunner at trunk level - the weapon would cut down and destroy the entire tree, and the sniper with it.AAA Weapons of the U.S. Army, Part I: The "Quad 50" Machine Gun Mount, 225th AAA Searchlight Battalion (Skylighters) ArticleThe M2HB was not widely used in the Pacific campaign, due to several factors, including weight, the inherent nature of infantry jungle combat, and because road intersections were usually easily outflanked.George, John B., Shots Fired In Anger, NRA Press (1981), p. 404 However, it was used by fast-moving motorized forces in the Philippines to destroy Japanese blocking units on the advance to Manila. The quad mount .50 was also used to destroy Japanese emplacements.An M2 overlooking the Korengal Valley at Firebase Phoenix, Afghanistan, in 2007The M2HB saw service in both Korean WarKorea and Vietnam WarVietnam. In 2003, during the Iraq War, U.S. Army SFC Paul Ray Smith used his M2HB mounted on an M113 armored personnel carrier to kill twenty to fifty enemy who were attacking a U.S. Army outpost, saving an aid station from being overrun and allowing wounded soldiers to be evacuated,Schmitt, Eric, Medal of Honor to Be Awarded to Soldier Killed in Iraq, a First, New York Times, 30 March 2005 SFC Smith gave his life to save his fellow soldiers and was posthumously awarded the Medal of Honor. Commonwealth forcesCommonwealth of NationsCommonwealth use of the M2 Browning .50 caliber machine gun (known as the .5 Browning in British and Commonwealth service) was limited in the Second World War, though from 1942 it was standard armament on US-built AFVs provided under lend-lease such as the M4 Sherman, M7 Priest, M8 Greyhound, or M10 Wolverine variously used by United KingdomBritish, Canadian, Australian, South African and New Zealand units. Nevertheless, the heavy Browning's effectiveness was praised by many British and Commonwealth soldiers in infantry, armored, and ordnance branches.Shore, C. (Capt.), With British Snipers to the Reich, Boulder: Lancer

Militaria, p. 197-198Dunlap, Roy F., Ordnance Went Up Front, Samworth Press (1948), p. 35, 145 Many commanders thought the .50 Browning the best weapon in its class, certainly the best of the American weapons, including the M1 Garand and carbine.Shore, C. (Capt.), With British Snipers to the Reich, Boulder: Lancer Militaria, p. 197-198: They especially liked the "hell's brew" of AP, API, and APIT ammunition. In North Africa, after Commonwealth units began to obtain sufficient parts, manuals, gauges, and ammunition for the new weapon, the .50 Browning was increasingly used, eventually replacing the 15 mm Besa, but in Italy was often deleted from top turret mountings because the mount exposed the operator to low branches and enemy fire.Dunlap, Roy F., Ordnance Went Up Front, Samworth Press (1948), p. 153: The New Zealand and South African divisions in particular loved the big Browning, and were frequently encountered trading for spare parts and gauges. Some Special Air ServiceSAS units used the aircraft (AN/M2) version of the gun, while turret-mounted .5 Brownings were used later in the war in such aircraft as the Avro LancasterLancaster bomber. After the Second World War, the .50 Browning continued to see action in Korean WarKorea and other theaters, in aircraft, tripod (ground), ground AA (hip-ring), and vehicle mounts. One of its most notable actions in a ground role was in a fierce battle with a nine-man SAS team at the Battle of Mirbat in Oman in July 1972, where the heavy Browning and its API ammunition was used to help repulse an assault by 250 Yemeni Popular Front for the Liberation of OmanAdoo guerrillas, though the more famous weapon from the battle is a 25 pounder gun.Kennedy, Michael Paul, Soldier I: SAS, London: Bloomsbury Publishing PLC (1990), ISBN 0747507503A .50 caliber Browning was installed along with a .30 caliber Browning machine gun in each compact one-man turret on M113 APCs used by the Royal Australian Armoured Corps in South Vietnam. M2 as a sniper rifle The M2 machine gun has also been used as a long-range sniper rifle, when equipped with a telescopic sight. Soldiers during the Korean War used scoped M2s in the role of a sniper rifle, but the practice was most notably used by US Marine Corps sniper Carlos Hathcock during the Vietnam War. Using an Unertl telescopic sight and a mounting bracket of his own design, Hathcock could quickly convert the M2 into a sniper rifle, using the traversing-and-elevating (T&E) mechanism attached to the tripod (weapon)tripod to assist in aiming at stationary targets. When firing semi-automatically, Hathcock hit man-size targets beyond 2000 yards—twice the range of a standard-caliber sniper rifle of the time (a .30-06 Winchester Model 70). In fact, Hathcock set the record for the longest confirmed kill at 2,460 yards or 1.3 miles (2,250 m), a record which stood until 2002. "Sniper Rifles". GlobalSecurity. . Retrieved 2008-03-24. "When a 24-year old Marine sharpshooter named Carlos Norman Hathcock II chalked up the farthest recorded kill in the history of sniping—2,500 yards (1.42 miles, a distance greater than 22 football fields) in February 1967, he fired a Browning M2 .50 Cal. Machine Gun."Sgt. Grit (2006). "Marine Corps Sniper Carlos N. Hathcock II". . Retrieved 2008-03-24. "Viet Cong shot dead by a round fired from a scope-mounted Browning M-2 .50 caliber machine gun at the unbelievable range of 2500 yards (2300 m)."Variants and derivativesM2 variantsAn M2HB in the 2nd Foreign Infantry RegimentFrench Foreign Legion's 2nd Infantry Regiment during an exercise.The basic M2 was deployed in US service in a number of subvariants, all with separate complete designations as per the US Army system. The basic designation as mentioned in the introduction is Browning Machine Gun, Cal. .50, M2, with others as described below. The development of the M1921 Browning machine gunM1921 water-cooled machine gun which led to the M2, meant that the initial M2s were in fact water-cooled. These weapons were designated Browning Machine Gun, Cal. .50, M2, Water-Cooled, Flexible. There was no fixed water-cooled version. Improved air-cooled heavy barrel versions came in three subtypes. The basic infantry model, Browning Machine Gun, Cal. .50, M2, HB, Flexible, a fixed developed for use on the M6 Heavy Tank designated Browning Machine Gun, Cal. .50, M2, HB, Fixed, and a "turret type" whereby "Flexible" M2s were modified slightly for use in tank turrets. The subvariant designation Browning Machine Gun, Cal. .50, M2, HB, TT was only used for manufacturing, supply, and administration identification and separation from flexible M2s. A number of additional subvariants were developed after the end of the Second World War. The Caliber .50 Machine Gun, Browning, M2, Heavy Barrel, M48 Turret Type was developed for the commander's cupola on the M48 Patton tank. The cupola mount on the M48A2 and M48A3 was thoroughly disliked by most tankers, as it proved unreliable in service.Zumbro, Ralph, Tank Sergeant, Presidio Press (1986), p. 92 An externally mounted M2 was later adopted for the commander's position on the M1 Abrams tanks. Three subvariants were also developed for use by the United States NavyUS Navy on a variety of ships and watercraft. These included the Caliber .50 Machine Gun, Browning, M2, Heavy Barrel, Soft Mount (Navy) and the Caliber .50 Machine Gun, Browning, M2, Heavy Barrel, Fixed Type (Navy). The fixed types fire from a solenoid trigger and come in left or right hand feed variants for use on the Mk 56 Mod 0 dual mount and other mounts. M2E2/M2A1The M2E2 modification with quick-change barrelAn upgrade program for existing infantry M2HBs and other M2s currently in U.S. Army service, the E50 provides a quick-change barrel capability, a rail accessory mount, an improved flash hider, and a manual safety. When modified with the barrel, the weapon is designated as an M2E2,Fuller, BG Peter N.; COL Douglas A. Tamilio (18 MAY 2010). "Project Manager Soldier Weapons Briefing for NDIA". PEO Soldier. United States Army. . Retrieved 28 October 2010. while the total conversion is sometimes referred to as the M2A1. The E50 designation refers to "Enhanced 50", the modification program and conversion kit, rather than the weapon itself. Aircraft gunsAN/M2U.S. Marines man pintle-mounted M2HB machine gunsA German Army door gunner mans an M3M onboard a Sikorsky CH-53 Sea StallionCH-53 helicopter. The M2 machine gun was widely used during World War II and in later postwar conflicts as a remote or flexible aircraft gun. For fixed (offensive) or flexible (defensive) guns used in aircraft, a dedicated M2 version was developed called the .50 Browning AN/M2. The "AN" stands for "Army/Navy", since the gun was developed jointly for use by both services (unusual for the time, when the delineations between the Army and Navy were much stricter, and relations between armed services were often cool, if not down-right hostile). The AN/M2 had a cyclic rate of 750–850 rounds per minute, with the ability to be fired from an electrically operated remote-mount solenoid trigger when installed as a fixed gun. Cooled by the aircraft's slip-stream, the air-cooled AN/M2 was fitted with a substantially lighter barrel, which also had the effect of increasing the rate of fire. The official designation for this weapon was Browning Machine Gun, Aircraft, Cal. .50, AN/M2 (Fixed) or (Flexible). The XM296/M296 is a further development of the AN/M2 machine gun for the OH-58 KiowaOH-58 Kiowa Warrior helicopter. The M296 differs from previous remote firing variants in that it has adjustable maximum firing rate (500–850 rpm), while lacking a bolt latch (allowing single-shot operation).M296 .50 cal. (12.7 mm) Machine Gun Article As an air-cooled gun used aboard a relatively slow rotary-wing aircraft, the M296 has a burst restriction rate of 50 rounds per minute; combat firing, which exceeds this limit, mandates a ten-minute cooling period to avoid malfunctions due to overheating.M296 .50 cal. (12.7 mm) Machine GunXM213/M213, XM218, GAU-15/A, GAU-16/A, and GAU-18/AThe XM213/M213 was a modernization and adaptation of existing .50 caliber AN/M2s in inventory for use as a pintle mounted door gun on helicopters using the U.S. Helicopter Armament Subsystems#UH-1 IroquoisM59 armament subsystem. The GAU-15/A, formerly identified as the XM218, is a lightweight member of the M2/M3 family. The GAU-16/A was an improved GAU-15/A with modified grip and sight assemblies for similar applications. Both of these weapons were used as a part of the U.S. Helicopter Armament Subsystems#UH-1 IroquoisA/A49E-11 armament subsystem (also known as the Defensive Armament System). The GAU-18/A, is a lightweight variant of the M2/M3, and is used on the USAF's MH-53 Pave Low and HH-60 Pave Hawk helicopters. These weapons do not use the heavy barrel, and are typically set up as left-hand feed, right-hand charging weapons, but on the HH-60 Pavehawks that use the EGMS (External Gun Mount System) all weapons are set up as right hand charge but vary between left and right hand feed depending on what side of the aircraft it is on. In this configuration the gun is fitted with a Chute (gravity)chute adapter attached to its left hand feed pawl bracket. Thus, the weapon can receive ammunition through a feed chute system connected to internally mounted or externally mounted ammunition cans. Originally designed to accommodate 1,700 rounds, these cans have since been modified due to space constraints, and now hold about half that amount with the external cans of the EGMS system holding 600 rounds each. However, many aerial gunners find the chute system cumbersome, and opt to install a bracket accommodating the 100-round cans instead. The GAU-18/A began to be supplanted by the GAU-21/A in 2006. AN/M3, GAU-21/A, and M3PDuring World War II, a faster-firing Browning was developed for aircraft use. The AN/M3 features a mechanical or electrically boosted feed mechanism to increase the rate of fire to around 1,200 rounds per minute. The AN/M3 was used in Korea on the F-86 Sabre, and in Vietnam in the U.S. aircraft gun podsXM14/SUU-12/A gun pod. Today, it can be found on the Embraer EMB 314 Super Tucano. The FN Herstal license-produced M3-series is used by the U.S. military in two versions; the M3M and

M3P. The fixed, remote-firing version, the FN M3P, was previously employed on the AN/TWQ-1 AvengerAvenger Air Defense System, and is currently being used on the OH-58 KiowaOH-58D; replacing the M296 .50 cal. machine gun. 6-6 Cavalry aircrews field new Kiowa Warrior weapons system. US Army. The M3M flexible machine gun has been adopted by the USAF and the USN under the designation GAU-21/A for use on helicopters. The GAU-21/A is also being used by the United States Marine Corps to upgrade from the aged XM218 .50 cal. machine gun for the CH-53E. Users The M2 family has been widely used abroad, primarily in its basic infantry configuration. A brief listing of designations for M2 family weapons follows: Country NATO Member Designation Description ArgentinaArgentinaJones, Richard D. Jane's Infantry Weapons 2009/2010. Jane's Information Group; 35 edition (January 27, 2009). ISBN 978-0710628695.No M2HB 12.7 × 99 mm Browning M2HB machine gun AustraliaAustraliaM2HB-QCB "Light Calibre Weapons". Adi-limited.com. . Retrieved 2008-09-08. AustriaAustria BelgiumBelgiumYes BeninBeninNo BoliviaBolivia BrazilBrazilMtr .50 M2 HB "BROWNING" BulgariaBulgariaYes Burkina FasoBurkina FasoNo BurundiBurundi CameroonCameroon CanadaCanadaYes FN M2HB-QCB ChadChadNo ChileChile ColombiaColombia Côte d'IvoireCote d'Ivoire CroatiaCroatiaYes Democratic Republic of the CongoDemocratic Republic of CongoNo DenmarkDenmarkYes M/50 TMG ? 12.7 × 99 mm FNH M3M machine gunCombat Support Wing (december 2007). "Eskadrille 615 støtter Søværnet [Squadron 615 aids the Navy]" (in Danish). Mjølner: 5. . DjiboutiDjiboutiNo 12.7 × 99 mm Browning M2HB machine gun Dominican RepublicDominican Republic EcuadorEcuador EgyptEgypt El SalvadorEl Salvador EthiopiaEthiopia FranceFranceYes GabonGabonNo The GambiaGambia GhanaGhana GermanyGermanyhttp://www.diesigns.com/down/HHK_CH-53.pdfYes M3M, MG50 GreeceGreece GuatemalaGuatemalaNo HondurasHonduras IndiaIndia IndonesiaIndonesia IranIran Republic of IrelandIreland.5 Heavy Machine Gun (HMG) Army Weapons - Heavy Machine Gun (HMG) IsraelIsrael ItalyItalyYes JamaicaJamaicaNo JapanJapan JordanJordan KuwaitKuwait LebanonLebanon LiberiaLiberia LithuaniaLithuaniahttp://kariuomene.kam.lt/lt/ginkluote_i LuxembourgLuxembourgMitrailleuse .50 M2 HB Armement MadagascarMadagascarNo MalaysiaMalaysia MauritaniaMauritania MexicoMexico MoroccoMorocco MyanmarMyanmar NetherlandsNetherlandsYes New ZealandNew ZealandNo NicaraguaNicaragua NigerNiger NigeriaNigeria NorwayNorwayYes OmanOmanNo PakistanPakistan PanamaPanama ParaguayParaguay PeruPeru PhilippinesPhilippines PortugalPortugalYes QatarQatarNo RomaniaRomaniaYes RwandaRwandaNo Saudi ArabiaSaudi Arabia SenegalSenegal SerbiaSerbia SingaporeSingapore SomaliaSomalia South AfricaSouth Africa SpainSpainYes SwedenSwedenhttp://www.forsvarsmakten.se/sv/Materiel-och-teknik/Vapen/Tung-kulsprutaNo Tung kulspruta (tksp) SwitzerlandSwitzerland Republic of ChinaTaiwanT90 ThailandThailand TogoTogo TongaTonga TunisiaTunisia TurkeyTurkeyYes United Arab EmiratesUnited Arab EmiratesNo United KingdomUnited KingdomYes L2A1 L6, L6A1 12.7 × 99 mm Browning M2HB machine gun; ranging gun for the Royal Ordnance L7L7 105 mm tank gun on the Centurion tankL11, L11A1 12.7 × 99 mm Browning M2HB machine gun; ranging gun L21A1 12.7 × 99 mm Browning M2HB machine gun; ranging gun for the 120 mm tank gun on the Chieftain tankL111A1 "Manroy Website". Manroy.co.uk. . Retrieved 2008-09-08.M3MMOD Defence News report of M3M acquisition for CHC mod.co.uk defence news accessed 26 Sept 201012.7 × 99 mm Browning M2HB machine gun; Upgraded M2 for use on Commando Helicopter Force and other units as helicopter door guns. United StatesUnited StatesBrowning Caliber .50 M2, M2HB, XM218/GAU-16, GAU-21 Browning Caliber .50 M2 Heavy Barrel machine gun UruguayUruguayNo 12.7 × 99 mm Browning M2HB machine gun VenezuelaVenezuela YemenYemen ZimbabweZimbabweNotesReferences Dunlap, Roy F. (1948). Ordnance Went Up Front, Samworth Press, OCLC 6081851 George, John B. (1981). Shots Fired In Anger, NRA Press, ISBN 093599842X Gresham, John D. (December 2001). “Weapons”. Military Heritage. Volume 3, No. 3: 22, 24, 26, 28, 30 (John Browning’s (M2) .50-caliber). Hogg, Ian. (2001). The American Arsenal. Ian Hogg, ed. London, UK: Greenhill Books, ISBN 9781853674709 MCWP 3-15.1: Machine Guns and Machine Gun Gunnery USMC

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Phalanx CIWS

Phalanx CIWS	
Phalanx (Block 1A) live fire test, USS *Monterey* (CG-61)	
Type	Close-in weapon system
Place of origin	United States
Service history	
In service	1980-Present
Used by	See *operators*
Wars	Gulf War
Production history	
Designer	General Dynamics (now Raytheon)
Manufacturer	General Dynamics (now Raytheon)
Produced	1978[1]
Specifications	
Weight	12500 lb (5700 kg), later models 13600 lb (6200 kg)[1]
Barrel length	• Block 0 & 1 (L76 gun barrel): 1520 mm (59.8 in) • Block 1B (L99 gun barrel): 1981 mm (78.0 in)[2]
Height	4.7 m (15 ft 5.0 in)
Crew	Automated, with human oversight
Shell	• Naval: Armor-piercing tungsten penetrator rounds with discarding sabots. • Land: High-Explosive Incendiary Tracer, Self-Destruct.
Caliber	20×102mm
Barrels	6
Elevation	• Block 0: -10°/+80° • Block 1: -20°/+80° (Rate of elevation: 86°/sec for Block 0/1) • Block 1B: -25°/+85° (Rate of elevation: 115°/sec)[2]

Traverse	• 150° from either side of centerline (Rate of traverse: 100°/sec for Block 0 & 1, 116°/sec for Block 1B)[2]
Rate of fire	3,000-4,500 rounds/minute [Selectable] (50-75 rounds/second).
Muzzle velocity	1100 m/s (3600 ft/s)[2]
Effective range	3.6 km (2.2 mi)[2]
Maximum range	Classified[1] [3]
Primary weapon	1× 20 mm (0.79 in) M61 Vulcan 6-barreled gatling cannon[4]
Guidance system	Ku-band radar and FLIR[5]

The **Phalanx CIWS** is an anti-ship missile defense system. It is a close-in weapon system (CIWS) and was designed and manufactured by the General Dynamics Corporation, Pomona Division[4] (now a part of Raytheon). Consisting of a radar-guided 20mm Gatling gun mounted on a swivelling base, the Phalanx is used by the United States Navy on every class of surface combat ship, by the United States Coast Guard aboard its *Hamilton*-class and *Legend* class cutters and the navies of 23 allied nations.

A land based variant known as *C-RAM* has recently been deployed in a short range missile defense role, to counter incoming rockets and artillery fire.[6]

Because of their distinctive barrel-shaped radome and their automated nature of operation, Phalanx CIWS units are sometimes nicknamed "*R2-D2*" after the famous droid from *Star Wars*,[7] [8] and in the Royal Navy as *Daleks*, after the aliens from *Doctor Who*.

History

Developed as the last line of automated weapons defense (terminal defense or point defense) against anti-ship missiles (AShMs), including high-*g* and maneuvering sea-skimmers, the first system was offered to the U.S. Navy for evaluation on USS *King* (DDG-41) in 1973. It was accepted and production started in 1978, the first ship fully fitted out was USS *Coral Sea* (CV-43) in 1980. The Navy began placing CIWS systems on non-combatant vessels in 1984.

Design

The basis of the system is the 20 mm M61 Vulcan Gatling gun autocannon, used since the 1960s by the United States military in nearly all fighter aircraft (and one land mounting, the M163 VADS), linked to a Ku-band radar system for acquiring and tracking targets. This proven system was combined with a purpose-made mounting, capable of fast elevation and traverse speeds, to track incoming targets. An entirely self-contained unit, the mounting houses the gun, an automated fire control system and all other major components, enabling it to automatically search for, detect, track, engage and confirm kills using its computer-controlled radar system. Due to this self-contained nature, Phalanx is ideal for support ships which lack integrated targeting systems and generally have limited sensors. The entire unit has a mass between 5,500 and 6,100 kg (12,400 to 13,500 lb).

Comparison with Modern CIWS

Comparison of some modern CIWS

	AK-630[9]	🇺🇸 **Phalanx CIWS** [10]	🇳🇱 **Goalkeeper CIWS**
Weight	9114 kg (20090 lb)	6200 kg (14000 lb)	9902 kg (21830 lb)
Armament	30 mm (1.2 in) 6 barreled GSh-6-30 Gatling Gun	20 mm (0.79 in) 6 barreled M61 Vulcan Gatling Gun	30 mm (1.2 in) 7 barreled GAU-8 Gatling Gun
Rate of Fire	5000 rounds per minute	4500 rounds per minute	4200 rounds per minute
Range	4000 m (13000 ft)	3600 m (11800 ft)	2000 m (6600 ft)
Ammunition stowage	2000 rounds	1550 rounds	1190 rounds
Muzzle velocity	900 m (3000 ft) per second	1100 m (3600 ft) per second	1109 m (3638 ft) per second
Elevation	-12 to +88 degrees	-25 to +85 degrees	-25 to +85 degrees
Traverse	360 degrees	-150 to +150 degrees	360 degrees

Upgrades

Due to the continuing evolution of both threats and computer technology, the Phalanx system has, like most military systems, been developed through a number of different configurations. The basic (original) style is the Block 0, equipped with first generation solid state electronics and with marginal capability against surface targets. The Block 1 (1988) upgrade offered various improvements in radar, ammunition, rate of fire, increasing engagement elevation to +70 degrees, and computing. These improvements were intended to increase the system's capability against emerging Russian supersonic anti-ship missiles. Block 1A introduced a new computer system to counter more maneuverable targets. The Block 1B PSuM (Phalanx Surface Mode, 1999) adds a forward looking infrared (FLIR) sensor to allow the weapon to be used against surface targets.[11] This addition was developed to provide ship defense against small vessel threats and other "floaters" in littoral waters and to improve the weapon's performance against slower low-flying aircraft. The FLIR's capability is also of use against low-observability missiles and can be linked with the RIM-116 Rolling Airframe Missile (RAM) system to increase RAM engagement range and accuracy. The Block 1B also allows for an operator to visually identify and target threats.[11]

The U.S. is in the process of upgrading all their Phalanx systems to the Block 1B configuration. The Block 1B is also used by other navies such as Canada, Portugal, Japan, Egypt, Bahrain and the UK.[12]

In May 2009 the US Navy awarded a $260 million contract to Raytheon Missile Systems to perform upgrades and other work on the Phalanx. The work is to be completed by September 2012.[13]

Operation

The CIWS is designed to be the last line of defense against anti-ship missiles. Due to its design criteria its effective range is very short relative to the range of modern ASMs, from 1 to 5 nautical miles (9 km). The gun mount moves at a very high speed and with great precision. The system takes minimal inputs from the ship, making it capable of functioning despite potential damage to the ship. The only inputs required for operation are 440 V AC at 60 Hz and water for electronics cooling. For full operation including some non-essential functions, it also has inputs for true compass ship's heading and 115 V AC for the PASS and tape drive subsystems.

Radar subsystems

The CIWS has two antennas that work together to engage targets. The first antenna, for searching, is located inside the radome on the weapon control group (top of the white-painted portion). The search subsystem provides bearing, range, velocity, heading, and altitude information of potential targets to the CIWS computer. This information is analyzed to determine whether the detected object should be engaged by the CIWS system. Once the computer identifies a valid target (see details below), the mount moves to face the target and then hands the target over to the track antenna. The track antenna is extremely precise, but views a much smaller area. The tracking subsystem observes the target until the computer determines that the probability of a successful hit is maximized and then, depending on the operator conditions, the system will either fire automatically or will recommend fire to the operator. While firing, the system tracks outgoing rounds and 'walks' them onto the target.

Gun and ammunition handling system

The Block 0 CIWS mounts (hydraulic driven) fired at a rate of 3,000 rounds per minute and they could only hold 989 rounds in the magazine drum.[4] The Block 1 CIWS mounts (hydraulic) also fired at 3,000 rounds per minute with an extended magazine drum holding 1,550 rounds. The Block 1A and newer (pneumatic driven) CIWS mounts fire at a rate of 4,500 rounds per minute and also had the larger 1,550 round magazine. The velocity of the rounds once fired is approximately 3600 feet per second (1100 m/s). The rounds are armor-piercing tungsten penetrator rounds or depleted uranium with discarding sabots. The kinetic projectiles are designed to pierce and explode an incoming missile's warhead. The ammunition handling system has two conveyor belt systems. The first takes the rounds out of the magazine drum and to the gun; the second takes either the empty shells or non-fired rounds and routes them back to the opposite end of the drum.

CIWS contact target identification

The CIWS does not recognize identification friend or foe, also known as IFF. The CIWS has only the data it collects in real time from the radars to decide if the target is a threat and to engage it. A contact has to meet multiple criteria for it to be considered a target. Some of the criteria are listed below.

1. Is the range of the target increasing or decreasing in relation to the ship? The CIWS search radar will see contacts that are out-bound and discard them. The CIWS will only engage a target if it is approaching the ship.
2. Is the contact capable of maneuvering to hit the ship? If a contact is not heading directly at the ship, the CIWS looks at its heading in relation to the ship and its velocity. It then decides if the contact can still perform a maneuver to hit the ship.
3. Is the contact traveling between the minimum and maximum velocities? The CIWS has the ability to engage targets that travel in a wide range of speeds, however it is not an infinitely wide range. The system has a target maximum velocity limit. If a target exceeds this velocity, the CIWS will not engage it. It also has a minimum target velocity limit. Any contact below that velocity will not be engaged by the CIWS. The operator also has the option to adjust the minimum and maximum limits within the limits of the system.

There are many other subsystems which together ensure proper operation, such as environmental control, transmitter, mount movement control, power control and distribution and so on. It takes 6 to 8 months to train a technician to maintain, operate, and repair the CIWS.

Incidents

Drone exercise accident

On February 10, 1983, USS Antrim (FFG-20) was conducting a live fire exercise off the east coast of the United States using the Phalanx against a target drone. Although the drone was successfully engaged at close range, the target debris bounced off the sea surface and struck the ship, causing significant damage and fire from the drone's residual fuel which killed a civilian instructor.[14] [15]

Iraqi missile attack in Gulf War I

On February 25, 1991, during the first Gulf War, the Phalanx-equipped USS *Jarrett* (FFG-33) was a few miles from the USS *Missouri* (BB-63) and the destroyer HMS *Gloucester* (D96). The ships were attacked by an Iraqi Silkworm missile (often referred to as the *Seersucker*), at which *Missouri* fired its SRBOC chaff. The Phalanx system on *Jarrett*, operating in the automatic target-acquisition mode, fixed upon *Missouri*'s chaff, releasing a burst of rounds. From this burst, four rounds hit *Missouri* which was two to three miles (about 5 km) from *Jarrett* at the time. There were no injuries.[16] A Sea Dart missile was then launched from the *Gloucester*, which destroyed the Iraqi missile, achieving the first successful engagement of a missile by a missile during combat at sea.

Accidental downing of US aircraft

On June 4, 1996, a Japanese Phalanx accidentally shot down a US A-6 Intruder that was towing a radar target during gunnery exercises. A Phalanx aboard the Asagiri class destroyer *Yūgiri* locked onto the Intruder instead of the target. Both pilots ejected safely.[17] A post-accident investigation concluded that the Yūgiri's gunnery officer gave the order to fire before the A-6 was out of the CIWS engagement envelope.[18] [19]

21st century

Centurion C-RAM

Seeking a solution to constant rocket and mortar attacks on bases in Iraq, the United States Army requested a quick-to-field anti-projectile system in May 2004, as part of its Counter-Rocket, Artillery, Mortar initiative.[20] The end result of this program was 'Centurion'. For all intents and purposes a terrestrial version of the Navy's CIWS, the Centurion was rapidly developed,[21] with a proof of concept test in November that same year. It began deployment to Iraq in 2005,[20] [22] where it was set up to protect forward operating bases and other high-value sites in and around the capital, Baghdad.[23] Israel has purchased a single system for testing purposes, and is reported[24] to be considering buying the system to counter rocket attacks and defend point military installations. Investments made in their own indigenous air defence system, Iron Dome, has provided competition to Centurion.[24] [25]

Centurion C-RAM

Each system uses consisted of a modified Phalanx 1B CIWS, powered by an attached generator and mounted on a trailer for mobility. Armed with a 20 mm M61A1 Gatling gun the unit is capable of firing 1,500 or 2,000 M246 or M940 rounds per minute.[6] [26] In 2008 there were more than twenty CIWS systems protecting bases in the U.S. Central Command area of operations. A Raytheon spokesman told *Navy Times* that 105 attacks were defeated by the systems, most of those involved mortars. Based on the success of Centurion, 23 additional systems were ordered in September 2008.[27]

Like the naval (1B) version, Centurion uses Ku-band radar and FLIR[28] to detect and track incoming projectiles, and is also capable of engaging surface targets, with the system able to reach a -25 degree elevation.[28] The Centurion is reportedly capable of defending a 1.2 km square area.[29] One major difference between the land and sea based variants is the choice of ammunition. Whereas naval Phalanx systems fire tungsten armor-piercing rounds, the C-RAM uses the M246 or M940 HEIT-SD (High-Explosive Incendiary Tracer, Self-Destruct) ammunition, originally developed for the M163 Vulcan Air Defense System.[21] [30] These rounds explode on impact with the target, or upon tracer burnout, thereby greatly reducing the risk of collateral damage, should any rounds fail to hit their target.[21] [30]

SeaRam

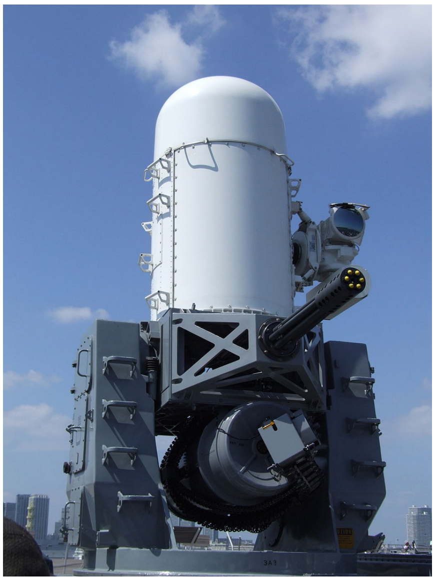
Utilising the armament of the RIM-116 Rolling Airframe Missile, and based on the mounting and targeting systems of the Phalanx, SeaRAM was developed in response to concerns about the performance of gun-based systems against modern, super-sonic sea-skimming anti-ship missiles. Designed as a companion self-defense system to Phalanx,[31] the SeaRAM is equipped with an 11 cell RAM launcher, and provides defense at a longer range. Due to the common mounting, SeaRAM inherits the relatively easy installation characteristics of its gun-based sibling, with Raytheon stating that "[SeaRAM] fits the exact shipboard installation footprint of the Phalanx, uses the same power and requires minimal shipboard modification".[31] Currently in the trial stages, SeaRAM is fitted to the Independence Class Littoral Combat Ship.[31]

Operators

- Australia[32]
- Bahrain[32]
- Canada[32]
- Greece[33]
- Egypt[34]
- Israel[32]
- Japan[34]
- New Zealand[32]
- Pakistan[32]
- Poland[32]
- Portugal[34]
- Saudi Arabia[32]
- Thailand[35]
- Taiwan[32]
- United States[34]
- United Kingdom[34]

Specifications (Block 1A/B)

- **Gun**: 1× 20 mm (0.79 in) M61 Vulcan 6-barreled gatling cannon[4]
- **Height**: 4.7 m (15 ft 5.0 in)
- **Weight**: 12500 lb (5700 kg), later models 13600 lb (6200 kg)[1]
- **Elevation** -25° to +85°
- **Muzzle velocity**: 1100 m/s (3600 ft/s)
- **Rate of fire**: 2,000 rounds/minute.
- **Maximum burst size**: 1000 rounds.
- **Ammunition capacity**: 1,550 rounds.
- **Radar**: Ku band.
- **100% Kill distance**: 8 miles (12.9 km)
- **Cost**: $1.5 Million (gun system only - no radar)



Block 1B Phalanx, with the improved barrel and FLIR.

Similar systems

- AK-630, Russian CIWS
- Kashtan, Russian Gun-Missile CIWS
- Goalkeeper CIWS, Dutch CIWS
- Meroka CIWS, Spanish navy
- RIM-116 Rolling Airframe Missile, U.S. missile-based
- Type 730 CIWS, Chinese CIWS

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External links

- Official United States Navy Warfighters Encyclopedia CIWS page (https://wrc.navair-rdte.navy.mil/warfighter_enc/weapons/shiplnch/Guns/ciws.htm)
- GlobalSecurity.org fact file (http://www.globalsecurity.org/military/systems/ship/systems/mk-15.htm)
- Raytheon Company Phalanx CIWS product page (http://www.raytheon.com/products/phalanx/)
- Ground based Phalanx in action (video) (http://www.videotiger.com/vids/amazingmilitarydefensiveweapon.wmv)

Mark 32 Surface Vessel Torpedo Tubes

The US **Mark 32 Surface Vessel Torpedo Tubes** (Mk 32 SVTT) system[1] is a pair of launchers fitted to warships since 1960 and still current as of 2009. Each launcher carries three tubes capable of discharging a lightweight torpedo such as the Mk 46, Mk 50 or Mk 54. Designed for close-in anti-submarine action, compressed air in a rear flask propels the weapon; the flask also acts as the tube's breech door. Depending on the modification (MOD) number of a particular tube, the mount may be manually or remotely operated from stowed to firing positions and may also be within the structure of the ship. Normal launch is electrically initiated by the fire control panel located in the combat information center of the ship. All of the torpedoes launched are fire-and-forget weapons.

The Mk 32 SVTT, made of fiberglass and aluminum, was originally designed to be weatherproof and capable of protecting loaded torpedoes from the elements; however, the tubes required extensive maintenance to do so. Beginning with the *Spruance*-class destroyer, designers placed Mk 32s inside the superstructure, usually within spaces that allowed additional weapon storage. In a fully ready condition, these tubes could be trained and fired remotely without any direct contact.

The breech device on the Mk 32 consists of a high pressure airflask that could be charged and stowed either on the tube or separately (on inside mounts only). When installed and with the muzzle cover removed, the tube is fired either remotely (electrical) or manually by opening the firing valve and allowing the flask to discharge its "air slug" directly into the tube. A small portion of this air operates a restraint latch and the torpedo is ejected clear of the ship's side where gravity drops it in the water.

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Mark 46 torpedo

A Mark 46 Mod 5A torpedo is inspected aboard the guided missile destroyer USS *Mustin*

Designed to attack high-performance submarines, the **Mark 46 torpedo** is the backbone of the U.S. Navy's lightweight ASW torpedo inventory, and is the current NATO standard. These aerial torpedoes, such as the Mark 46 Mod 5, are expected to remain in service until the year 2015. In 1989, a major upgrade program for the Mod 5 began to improve its shallow-water performance, resulting in the Mod 5A and Mod 5A(S).

General characteristics, Mark 46 Mod 5

- Primary Function: Air and ship-launched lightweight torpedo[1]
- Contractor: Alliant Techsystems
- Power Plant: Two-speed, reciprocating external combustion; Mono-propellant (Otto fuel II)
- Length: 8 ft 6 in (2.59 m) tube launch configuration (from ship)[2] , 14 ft 9 in (4.5 m) with ASROC rocket booster[1]
- Weight: 508 lb (231 kg)[1] (warshot configuration)
- Diameter: 12.75 in (324 mm)[2]
- Range: 12,000 yd (11 km)[1]
- Depth: > 1,200 ft (365 m)
- Speed: > 40 knots (46 mph, 74 km/h)[1]
- Guidance System: Homing mode: Active or passive/active acoustic homing[2]
- Launch/search mode: Snake or circle search
- Warhead: 96.8 lb (44 kg)[1] of PBXN-103 high explosive (bulk charge)
- Date Deployed: 1967 (Mod 0);[1] 1979 (Mod 5)

Yu-7 Torpedo

The Chinese Yu-7 torpedo is said to be based on the Mk 46 mod 2.[3] Currently the Chinese navy use the Yu-7 primarily as an ASW torpedo, deployed on ships and ASW helicopters.[4]

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External links

- Unofficial U.S. Navy Site: MK-46 Torpedo (http://www.navysite.de/weapons/mk-46.htm)
- FAS: MK-46 Torpedo (http://www.fas.org/man/dod-101/sys/ship/weaps/mk-46.htm)

Mark 50 torpedo

Mark 50 Advanced Lightweight Torpedo	
Mark 50 torpedo being fired	
Type	Torpedo
Place of origin	🇺🇸 United States
Service history	
Used by	🇺🇸 United States Navy
Production history	
Designer	Honeywell[1]
Designed	1974
Manufacturer	Alliant Techsystems
Produced	1991-
Specifications	
Weight	750 lb (340 kg)
Length	112 in (2.84 m)
Width	12.75 in (0.32 m)
Warhead	HE shaped charge[1]
Warhead weight	100 lb (45 kg)[1]
Engine	Stored Chemical Energy Propulsion System
Operational range	15 km Maximum [2] , 1,900 ft depth[3]
Speed	40+ knots (74+ km/h)[1]
Guidance system	Active/passive acoustic homing[1]

The **Mark 50 torpedo** is a U.S. Navy advanced lightweight torpedo for use against fast, deep-diving submarines. The Mk-50 can be launched from all ASW aircraft, and from torpedo tubes aboard surface combatant ships. The Mk-50 was intended to replace the Mk-46 as the fleet's lightweight torpedo.[1] Instead the Mark 46 will be replaced with the Mark 54 LHT.

The torpedo's Stored Chemical Energy Propulsion System (SCEPS) uses a small tank of sulfur hexafluoride gas which is sprayed over a block of solid lithium, which generates enormous quantities of heat, in turn used to generate steam from seawater. The steam propels the torpedo in a closed Rankine cycle, supplying power to a pump-jet.

General characteristics, Mk-50

- Primary function: air and ship-launched lightweight torpedo[1]
- Contractor: Alliant Techsystems, Westinghouse
- Length: 2.84 m (112 in)
- Weight: 340 kg (750 lb)
- Diameter: 324 mm (12.75 in)
- Speed: > 40 kn
- Power Plant: Stored Chemical Energy Propulsion System[1]
- Guidance system: Active/passive acoustic homing[1]
- Warhead: approximately 45 kg (100 lb) high explosive (shaped charge)[1]

Comparable Weapons

- Sting Ray torpedo

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Mk 13 missile launcher

The **Mk-13 guided missile launching system (GMLS)** is a single-arm missile launcher designed for use on frigates and other military vessels.

The Mark 13 is equipped to fire the RIM-66 Standard, RGM-84 Harpoon, and RIM-24 Tartar missiles for anti-air and anti-ship defense, and is capable of firing the Standard at a rate of one every eight seconds.[1] Its 40-round magazine consists of two concentric rings of vertically-stored missiles, 24 in the outer ring and 16 in the inner. In case of a fire, the system is equipped with magazine sprinkling, CO_2 suppression and booster suppression.

The Mk13 launcher is most typically employed as part of the Mk74 Guided Missile Launch System, or the Mk92 Fire Control System. Though the launcher was original armament on US *Perry*-class frigates (and their derivatives), in order to save costs on an obsolete system, by 2004 all active US vessels have had the system removed.[2] It was also fitted on *Cassard*-class frigates, as well as the last ten American Charles F. Adams class destroyers, the American California class cruisers, the German Lütjens class destroyers and Australian Perth class destroyers and Adelaide class frigates.

Because of its distinctive single-armed design, the Mk 13 is often referred to as the "one-armed bandit."

The **Mk-22 guided missile launching system (GMLS)** is a variation of the Mk-13 launcher which has only the inner 16 round storage ring of the Mk-13 launcher.[1]

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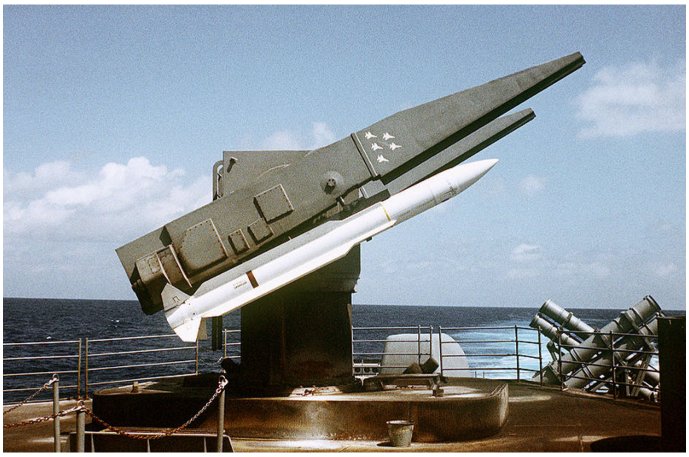
External links

- FAS Mk 13 GMLS (http://www.fas.org/man/dod-101/sys/ship/weaps/mk-13-gmls.htm)

RIM-66 Standard

RIM-66 Standard MR	
 A RIM-66 Standard MR on an Mk-26 launcher	
Type	Medium range surface-to-air missile
Place of origin	United States
Service history	
In service	1967 (RIM-66A SM-1MR Block I) 1979 (RIM-66C SM-2MR)[1]
Used by	United States Navy, Japanese Maritime Self-Defense Force, Turkish Navy, Royal Netherlands Navy, German Navy, Canadian Navy, and Others
Production history	
Manufacturer	Raytheon and others
Produced	1967 Onwards
Specifications	
Weight	SM-2 – 1558 lb (707 kg)
Length	15 ft 6 in (4.72 m)
Diameter	13.5 in (340 mm)
Warhead	blast fragmentation warhead
Detonation mechanism	radar and contact fuze
Engine	dual thrust, solid fuel rocket
Wingspan	3 ft 6 in (1.07 m)
Operational range	40 to 90 nmi (74 to 170 km)
Flight ceiling	> 24400 m (80100 ft)
Speed	Mach 3.5
Guidance system	**SM-2MR Block IIIA** Command and Inertial midcourse guidance with monopulse semi-active radar homing in the terminal phase of the interception. **SM-2MR Block IIIB** missiles have additionally dual infrared/semi-active terminal homing. **SM-1MR Block VI** missiles have monopulse semi-active radar homing without command and inertial mid-course guidance.[2]

Launch platform	Surface Ship

The **RIM-66 Standard MR** (SM-1MR/SM-2MR) is a medium range surface-to-air missile (SAM) originally developed for the United States Navy (USN). The SM-1 was developed as a replacement for the RIM-2 Terrier and RIM-24 Tartar that were deployed in the 1950s on a variety of USN ships. The RIM-67 Standard (SM-1ER/SM-2ER), is an extended range version of this missile with a booster stage.

Description

The Standard missile program was started in 1963 to produce a family of missiles to replace existing guided missiles used by the Terrier, Talos, and Tartar guided missile launch systems. The intention was to produce a new generation of guided missiles that could be retrofit to existing guided missile systems. [3]

Standard missile 1

The RIM-66A is the medium ranged version of the Standard missile and was initially developed as a replacement for the earlier RIM-24C as part of the Mk74 "Tartar" Guided Missile Fire Control System. It used the same fuselage as the earlier Tartar missile, for easier use with existing launchers and magazines for that system. The RIM-66A/B while looking like the earlier RIM-24C on the exterior is a different missile internally with redesigned electronics and a more reliable homing system and fuse that make it more capable than its predecessor. The RIM-66A/B Standard MR, (SM-1MR Block I to V) was used during the Vietnam War. The only remaining version of the Standard missile 1 in service is the RIM-66E (SM-1MR Block VI). No longer in service with the USN, the RIM-66E is still in service with Tartar Guided Missile Fire Control System equipped vessels, Mk 92 Guided Missile Fire Control System equipped vessels, and other compatible systems in several navies.

Standard missile 2

The RIM-66C/D Standard MR (SM-2MR Block I), was developed in the 1970s and was a key part of the Aegis combat system and New Threat Upgrade (NTU). The SM-2MR introduced inertial and command mid-course guidance. The missile's autopilot is programmed to fly the most efficient path to the target and can receive course corrections from the ground. Target illumination for semi-active homing is needed only for a few seconds in the terminal phase of the interception. This capability enables the Aegis combat system and New Threat Upgrade equipped vessels to time share illumination radars, greatly increasing the number of targets that can be engaged at one time. In the middle 1980s, the SM-2MR was deployed via Mk 41 Vertical Launch System (VLS) aboard the USS *Bunker Hill*, the first U.S. Navy ship to deploy a vertical launcher. VLS has, since 2003, been the only launcher used for the Standard missile in the U.S. Navy aboard *Ticonderoga*-class cruisers and *Arleigh Burke*-class destroyers.

The SM-1 and SM-2 were continuously upgraded through Blocks (see below).

The Standard can also be used against ships, either at line-of-sight range using its semi-active homing mode, or over the horizon using inertial guidance and terminal infrared homing.[4]

Contractors

Standard missiles were constructed by General Dynamics Pomona Division until 1992, when it became part of the Hughes Missile Systems Company. Hughes formed a joint venture with Raytheon called Standard Missile Company (SMCo). Hughes Missile Systems was eventually sold to Raytheon making it the sole contractor.[5]

Operational history

The Standard missile one became operational in 1968. The missile was utilized by ships equipped with the Tartar Guided Missile Fire Control System. The missile saw its first combat use in the early 1970s in the Vietnam war. The Standard missile two became operational in the late 1970s and was deployed operationally with the Aegis Combat System in 1983. Both Standard one and two were used against both surface and air targets during Operation Praying Mantis. On July 3, 1988, USS *Vincennes* (CG-49) shot down Iran Air Flight 655, an Airbus A300B2, using two SM-2MR missiles from her forward launcher.[6]

Deployment history

The Standard missile is designated by blocks depending upon their technological package.

SM-1 Medium Range Block I/II/III/IV, RIM-66A

The First Standard missiles entered service in the USN in 1967. Blocks I, II, and III were preliminary versions. Block IV was the production version. This missile was a replacement for the earlier RIM-24C Tartar missile.

SM-1 Medium Range Block V, RIM-66B

The RIM-66B introduced changes that resulted in higher reliability. A new faster reacting autopilot, a more powerful dual thrust rocket motor, and a new warhead were added. Many RIM-66A missiles were re-manufactured into RIM-66B.

SM-1 Medium Range Blocks VI/VIA/VIB, RIM-66E

The RIM-66E was the last version of the standard missile one medium range. This version entered service in 1983 [7] with the United States Navy and export customers. The RIM-66E was used by all remaining Tartar vessels that were not modified to use the New Threat Upgrade and Oliver Hazard Perry class frigates which controlled it with the Mk92 fire control system. The missile was retired from USN service in 2003; however it is still widely used abroad and is expected to remain viable until 2020.[8]

SM-2 Medium Range Block I, RIM-66C/D

The RIM-66C was the first version of the Standard missile two. The missile became operational in 1978 with the Aegis combat system fitted to the Ticonderoga class cruiser. The RIM-66D was the SM-2 medium range block I version for the New Threat Upgrade. The SM-2 incorporates a new autopilot giving it inertial guidance in all phases of flight except for the terminal intercept where semi-active radar homing is still used. This version is no longer in service, remaining missiles have either been remanufactured into later models or have been put in storage.

SM-2 Medium Range Block II, RIM-66G/H/J

The Block II missile introduced in 1983 with a new rocket motor for longer range and a new warhead. The RIM-66G is for the Aegis combat system and the Mk26 missile launcher. The RIM-66H is for Aegis and the Mk41 vertical launcher. The RIM-66J is the version for the New Threat Upgrade. Block II missiles are no longer manufactured, and have been withdrawn from service. The remainder have either been put in storage, or remanufactured into later models.

SM-2 Medium Range Block III/IIIA/IIIB, RIM-66K/L/M

The RIM-66M is the version of the Standard missile two medium range (SM-2MR) currently in service with the USN aboard Ticonderoga class cruisers, and Arleigh Burke class destroyers. The missile is specifically designed for the Aegis Combat System and the Mk41 Vertical launch system. The Block III missiles differ from earlier blocks by the addition of the MK 45 MOD 9 target detecting device, for improved performance against low altitude targets. The Block IIIB missile additionally has a dual semi-active/infrared seeker for terminal homing. The dual seeker is intended for use in high-ECM environments, against targets over the horizon or with a small radar cross section.[8] The seeker was originally developed for the canceled AIM-7R Sparrow air-to-air missile. All USN Block III and IIIA missiles are to be upgraded to Block IIIB. Block IIIA missiles are operated by the Japanese Maritime Self-Defense Force on its Kongo class and Atago class Aegis destroyers. Aegis equipped vessels in the Spanish and South Korean navies use it as well. The Dutch and German Navies have added it to the Anti-Air Warfare system, which uses the Thales Nederland Active Phased Array Radar and Smart-L radar. South Korean KDX-II destroyers use the block IIIA with a New Threat Upgrade compatible guided missile fire control system. Block III variants for Aegis and arm launchers are designated RIM-66L. Block III missiles for New Threat Upgrade systems is designated RIM-66K. Block IIIB missiles were not produced for the New Threat Upgrade. Blocks IIIA and IIIB are the current production versions. The Thales Nederland STIR 1.8 and 2.4 fire control systems are also supported.[2]

Deployment

In the US Navy, RIM-66 Standard was deployed on ships of the following classes, replacing RIM-24 Tartar in some cases:

- *Charles F. Adams* class destroyer (Mk74 Missile Fire Control)
- *Albany* class cruiser (Mk74 Missile Fire Control)
- *Oliver Hazard Perry* class frigate (Mk 92 Missile Fire Control)
- *Kidd* class destroyer (Mk74 Missile Fire Control SM-1/later New Threat Upgrade for SM-2)
- *California* class cruiser (Mk74 Missile Fire Control SM-1/later New Threat Upgrade for SM-2)
- *Virginia* class cruiser (Mk74 Missile Fire Control SM-1/later New Threat Upgrade for SM-2)
- *Ticonderoga* class cruiser (Aegis Combat System)
- *Arleigh Burke* class destroyer (Aegis Combat System)

RIM-66 has also been widely exported and is in service in other navies worldwide.

Surface to air variants

Designation	Block	Platform	Notes
RIM-66A	SM-1MR Block I to IV	Digital Tartar	In Service 1967, Conscan radar seeker. All rebuilt into Block V missiles
RIM-66B	SM-1MR Block V	Digital Tartar	Plane scanning seeker
RIM-66C	SM-2MR Block I	Aegis combat system, Mk26 launcher	MK 115 blast-fragmentation warhead Monopulse seeker for ECM resistance
RIM-66D	SM-2MR Block I	New Threat Upgrade	First New Threat Upgrade version
RIM-66E	SM-1MR Blocks VI, VIA, VIB	Digital Tartar and Mk 92 Fire Control System.	In service 1983. Version still in service with export customers. Adds monopulse seeker developed for Standard missile 2.
RIM-66G	SM-2MR Block II	Aegis combat system, Mk26 launcher	In Service 1983.
RIM-66H	SM-2MR Block II	Aegis combat system, Mk41 Launcher	Added Thiokol MK 104 rocket motor, increasing range High-velocity fragmentation warhead
RIM-66J	SM-2MR Block II	New Threat Upgrade	
RIM-66K-1	SM-2MR Block III	New Threat Upgrade	
RIM-66K-2	SM-2MR Block IIIA	New Threat Upgrade	In Production.
RIM-66L-1	SM-2MR Block III	Aegis combat system, Mk26 launcher	
RIM-66L-2	SM-2MR Block IIIA	Aegis combat system, Mk26 launcher	
RIM-66M-1	SM-2MR Block III	Aegis combat system, Mk41 Launcher	Improved MK 45 MOD 9 target detecting device, for low altitude targets
RIM-66M-2	SM-2MR Block IIIA	Aegis combat system, Mk41 Launcher	MK 125 warhead. In production.
RIM-66M-5	SM-2MR Block IIIB	Aegis combat system, Mk41 Launcher	Missile Homing Improvement Program (MHIP), dual IR / SARH seeker, IR seeker mounted on side fairing. In Production.

Table sources, reference material: [7] [1] [9] [8]

Operators

Australia

- Royal Australian Navy

Canada

- Canadian Navy

Chile

- Chilean Navy (Jacob van Heemskerck class frigate)

France

Germany

- German Federal Navy

Italy

Japan

- Japan Maritime Self Defense Force

Poland

- Polish Navy (Onboard *Oliver Hazard Perry* Frigates)

Republic of Korea

- Republic of Korea Navy

Netherlands

- Royal Netherlands Navy

United States

- United States Navy

Spain

- Spanish Navy

Turkey

- Turkish Navy

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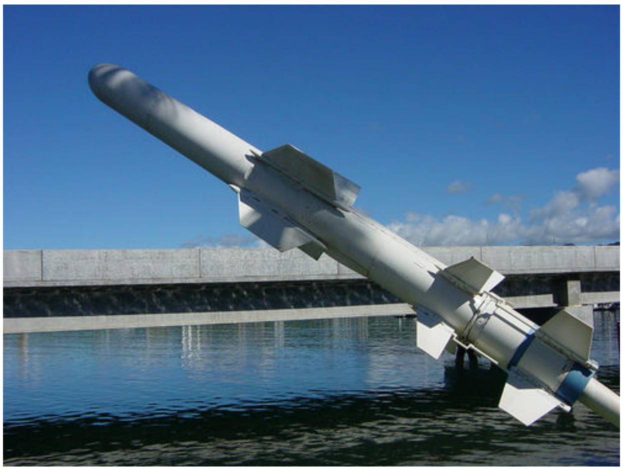
[8] USNI Combat Fleets 2005-2006, Wertheim, Eric; Editor, USN section Naval Institute Press © 2005

[9] SM-2 RIM-66 / RIM-67 Standard Missile (http://www.globalsecurity.org/military/systems/munitions/sm-2.htm)

External links

- Raytheon Standard missile website, mfr of Standard missiles (http://www.raytheon.com/products/standard_missile/)
- Navy Fact file - Standard Missile 2 (http://www.navy.mil/navydata/fact_display.asp?cid=2200&tid=1200&ct=2)
- NAVAIR War fighters encyclopedia - Standard missile (http://wrc.navair-rdte.navy.mil/warfighter_enc/weapons/shiplnch/standard.htm)
- Designation systems.net RIM-66 (http://www.designation-systems.net/dusrm/m-66.html)
- FAS - SM-2 (http://www.fas.org/man/dod-101/sys/missile/sm-2.htm)
- GlobalSecurity.org - SM-2 (http://www.globalsecurity.org/military/systems/munitions/sm-2.htm)

Harpoon (missile)

Harpoon	
 A *Harpoon* missile on display at the USS *Bowfin* museum at Pearl Harbor, Hawaii.	
Type	Anti-ship missile
Place of origin	United States
Service history	
In service	1977–present
Production history	
Manufacturer	McDonnell Douglas Boeing Defense, Space & Security
Unit cost	US$1,200,000 for Harpoon Block II[1]
Specifications	
Weight	1523 lb (691 kg) with booster
Length	Air launched: 12.6 ft (3.8 m); Surface and submarine launched: 15 ft (4.6 m)
Diameter	1.1 ft (0.34 m)
Warhead	488 pounds (221 kg)
Engine	Teledyne Turbojet/solid propellant booster for surface and submarine launch; greater than 600 pounds (greater than 272.2 kg) of thrust
Wingspan	3 ft (0.91 m)
Operational range	in excess of 67 nmi (124 km) depending on launch platform
Flight altitude	Sea-skimming
Speed	537 miles per hour (864 km/h)(240 m/s)
Guidance system	Sea-skimming cruise monitored by radar altimeter / active radar terminal homing
Launch platform	multi-platform: • RGM-84A surface-launched • AGM-84A air-launched • UGM-84A submarine-launched

The **Harpoon** is an all-weather, over-the-horizon, anti-ship missile system, developed and manufactured by McDonnell Douglas (now Boeing Defense, Space & Security). In 2004, Boeing delivered the 7,000th Harpoon unit since the weapon's introduction in 1977. The missile system has also been further developed into a land-strike weapon, the Standoff Land Attack Missile (SLAM).

The regular Harpoon uses active radar homing, and a low-level, sea-skimming cruise trajectory to improve survivability and lethality. The missile's launch platforms include:

- Fixed-wing aircraft (the **AGM-84**, without the solid-fuel rocket booster)
- Surface ships (the **RGM-84**, fitted with a solid-fuel rocket booster that detaches when expended, to allow the missile's main turbojet to maintain flight)
- Submarines (the **UGM-84**, fitted with a solid-fuel rocket booster and encapsulated in a container to enable submerged launch through a torpedo tube);
- Coastal defense batteries, from which it would be fired with a solid-fuel rocket booster.

The missile is comparable to the French-made Exocet missile, the Swedish RBS-15 missile, the Russian SS-N-25 Switchblade, the British Sea Eagle missile, and the Chinese Yingji.

Development

The Harpoon was first introduced in 1977 after the sinking of the Israeli destroyer *Eilat* in 1967 by a Soviet-built Styx anti-ship missile from an Egyptian missile boat. Initially developed as an air-launched missile for the United States Navy P-3 Orion patrol planes, the Harpoon has been adapted for use on U.S. Air Force B-52H bombers, which can carry from eight to 12 of the missiles. The Harpoon missile has been purchased by many American allies, especially by the NATO countries, as well as Australia, New Zealand, Japan, South Korea, etc., in other parts of the world.

The Harpoon has also been adapted for carriage on the F-16 Fighting Falcon, in operation by the U.S. Air Force, Singapore, South Korea, Taiwan, and the United Arab Emirates. It has been carried by several U.S. Navy aircraft, including the P-3 Orion patrol plane, the A-6 Intruder, the S-3 Viking, the AV-8B Harrier II, and the F/A-18 Hornet.

The Royal Australian Air Force can fire AGM-84 series missiles from its F-111C/G Aardvarks, F/A-18 Hornets, and P-3C Orion aircraft. The Royal Australian Navy deploys the Harpoon on major surface combatants and in the *Collins*-class submarines. The Spanish Air Force and the Chilean Navy are also AGM-84D customers, and they deploy the missiles on surface ships, F/A-18s, F-16s, and P-3 Orion aircraft. The British Royal Navy deploys the Harpoon on several types of surface ships and the Royal Air Force carries it on its Nimrod MR2 maritime patrol plane.

The Canadian Forces Maritime Command (Canadian Navy) carries Harpoon missiles on its *Halifax*-class frigates. The Royal New Zealand Air Force has the capability of carrying the Harpoon on its five P-3 Orion patrol planes - as its only means of striking surface ships.

The Republic of Singapore Air Force also operates five modified Fokker 50 Maritime Patrol Aircraft (MPA) which are fitted with the sensors needed to fire the Harpoon missile. The Pakistani Navy carries the Harpoon missile on its naval frigates and P-3C Orions. The Turkish Navy carries Harpoons on surface warships and Type 209 submarines. The Turkish Air Force will be armed with the SLAM-ER.

At least 339 Harpoon missiles were sold to the Republic of China Air Force (Taiwan) for its F-16 A/B Block 20 fleet and the Taiwanese Navy, which operates four guided-missile destroyers and sixteen guided-missile frigates with the capability of carrying the Harpoon, include the eight former U.S. Navy *Knox* class frigates and the eight locally-built derivative of the *Oliver Hazard Perry* class frigates. There are also the four former U.S.N. Kidd class guided-missile destroyers, which have been sold to Taiwan and have the capability of carrying Harpoon missiles. Plus the 2 Zwaardvis/Hai Lung submarines and 12 P-3C can launch Harpoon missiles.

The Block 1 mistiles were designated AGM/RGM/UGM-84A in US service and UGM-84B in UK version. Block 1B standard missiles were designated AGM/RGM/UGM-84C, Block 1C missiles were designated AGM/RGM/UGM-84D,

Harpoon Block ID

This version featured a larger fuel tank and re-attack capability, but was not produced in large numbers because its intended mission (warfare with the Warsaw Pact countries of Eastern Europe) was considered to be unlikely following the events of 1991-92. Range is 278 km. Block 1D missiles were designated RGM/AGM-84F.

SLAM ATA (Block IG)

This version, under development, gives the SLAM a re-attack capability as well as an image comparison capability similar to the Tomahawk cruise missile; that is, the weapon can compare the target scene in front of it with an image stored in its on-board computer during terminal phase target acquisition and lock on.[2] Block 1G missiles AGM/RGM/UGM-84G, and the SLAM-ER missiles are designated AGM-84H.

Harpoon Block 1J

Block 1J was a proposal for a further upgrade, AGM/RGM/UGM-84J Harpoon (or Harpoon 2000), for use against both ship and land targets.

Harpoon Block II

Harpoon Block II test firing from USS *Decatur*.

In production at Boeing facilities in Saint Charles, Missouri, is the Harpoon Block II, intended to offer an expanded engagement envelope, enhanced resistance to electronic countermeasures and improved targeting. Specifically, the Harpoon was initially designed as an open-ocean weapon. The Block II missiles continue progress begun with Block IE, and the Block II missile provides the Harpoon with a littoral-water anti-ship capability.

The key improvements of the Harpoon Block II are obtained by incorporating the inertial measurement unit from the Joint Direct Attack Munition program, and the software, computer, Global Positioning System (GPS)/inertial navigation system and GPS antenna/receiver from the SLAM Expanded Response (SLAM-ER), an upgrade to the SLAM.

Although initially tested from U.S. Navy ships, the decision was made to not procure Harpoon Block II for the U.S. Navy fleet. Boeing lists 28 foreign navies as Block II customers.

(http://www.boeing.com/defense-space/missiles/harpoon/docs/HarpoonBlockIIBackgrounder.pdf)

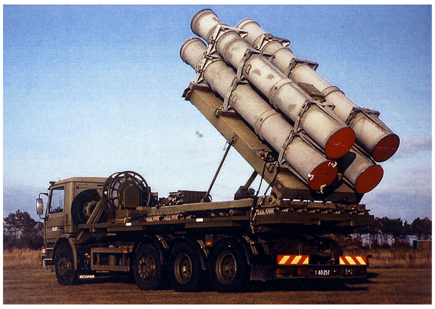
India acquired 24 Harpoon Block II missiles to arm its maritime strike Jaguar fighters in a deal worth $170 million through the Foreign Military Sales system.[3] In December 2010, the Defense Security Cooperation Agency (DSCA) notified U.S. Congress of a possible sale of 21 additional AGM-84L HARPOON Block II Missiles and associated equipment, parts and logistical support for a complete package worth approximately $200 million; the Indian government intends to use these missiles on its Indian Navy P-8I Neptune maritime patrol aircraft.[4]

Range is 278 km. Harpoon Block 2 missiles are designated AGM/RGM/UGM-84L.

Harpoon Block III

Harpoon Block III was intended to be an upgrade package to the existing USN Block 1C missiles and Command Launch Systems (CLS) for guided-missile cruisers, guided-missile destroyers, and the F/A-18E/F Super Hornet fighter aircraft. After experiencing an increase in the scope of required government ship integration, test and evaluation, and a delay in development of a data-link, the Harpoon Block III program was canceled by the U.S. Navy in April 2009. Cancellation of Block III however does not preclude the possibility of continued incremental upgrades to the Harpoon missile and launching suite in the future.

Operational history



Block I coastal missile defense system truck, in service in the Danish Navy 1988-2003

In 1981 and 1982 there were two accidental launches of Harpoon missiles. One from U.S.N. and one from a Danish Navy frigate (*Peder Skram*-class) on 6 September 1982 which ended in the recreational housing area Lumsås. The Danish missile was later known as the *hovsa-missile* (*hovsa* being the Danish term for *oops*).

In November 1980 during Operation Morvarid Iranian missile boats attacked and sank two Iraqi Osa class missile boats, one of the weapons used was the Harpoon missile.

In 1986, the United States Navy sank at least two Libyan patrol boats in the Gulf of Sidra. Two Harpoon missiles were launched from the USS *Yorktown* with no confirmed results and several others from A-6 Intruder aircraft that were said to have hit their targets.[5] [6] Initial reports claimed that the *USS Yorktown* scored hits on a patrol boat, but action reports indicated that the target may have been a false one and that no ships were hit by those missiles.[7]

In 1988, Harpoon missiles were used to sink the Iranian frigate *Sahand* during Operation Praying Mantis. Another was fired at the Sina class missile boat *Joshan*, but failed to strike because the Fast Attack Craft (FAC) had already been mostly sunk by RIM-66 Standard missiles. An Iranian-owned Harpoon missile was also fired at the guided missile cruiser USS *Wainwright*. The missile was successfully lured away by chaff.[8]

In December 1988, a Harpoon launched by an F/A-18 Hornet fighter from the aircraft carrier USS *Constellation*[9] killed one sailor when it struck the merchant ship *Jagvivek*, a 250 ft (76 m) long Indian-owned ship, during an exercise at the Pacific Missile Range near Kauai, Hawaii. A Notice to Mariners had been issued warning of the danger, but the *Jagvivek* strayed into the test range area, and the Harpoon missile, fortunately loaded just with an inert dummy warhead, locked onto it instead of its intended target.

In June 2009, it was reported by an American newspaper, citing unnamed officials from the Obama administration and the U.S. Congress, that the American government had accused Pakistan of illegally modifying some older Harpoon missiles to strike land-based targets. Pakistani officials denied this and they claimed that the United States was referring to a new Pakistani-designed missile. Some international experts were also reported to be very sceptical of the accusations. Robert Hewson, editor of Jane's Air Launched Weapons, pointed out that the Harpoon is not suitable for the land-attack role due to deficiency in range. He also stated that Pakistan was already armed with more sophisticated missiles of Pakistani or Chinese design and, therefore, "beyond the need to reverse-engineer old U.S. kit." Hewson offered that the missile tested by Pakistan was part of an undertaking to develop conventionally armed missiles, capable of being air- or surface-launched, to counter its rival India's missile arsenal.[10] [11] [12] It was later stated that Pakistan and the U.S. administration had reached some sort of agreement allowing U.S. officials to inspect Pakistan's inventory of Harpoon missiles,[13] [14] and the issue had been resolved.[15]

Operators

Australia

- Royal Australian Navy
- Royal Australian Air Force

Canada

- Canadian Forces Maritime Command

Chile

- Chilean Navy

Denmark

- Royal Danish Navy

Germany

- German Federal Navy

Greece

- Hellenic Navy

Iran

- Islamic Republic of Iran Navy

Israel

- Israeli Air Force
- Israeli Navy

India

- Indian Air Force

Japan

- Japan Maritime Self Defense Force

Republic of Korea

- Republic of Korea Navy

Malaysia

- Royal Malaysian Air Force

Netherlands

- Royal Netherlands Navy

Pakistan

- Pakistan Navy

Saudi Arabia

- Royal Saudi Navy

Singapore

- Republic of Singapore Air Force
- Republic of Singapore Navy

Spain

- Spanish Air Force
- Spanish Navy

Taiwan

- Taiwan Air Force
- Taiwanese Navy

Thailand

- Royal Thai Navy

Turkey

- Turkish Air Force
- Turkish Navy

United Arab Emirates

United Kingdom

- Royal Air Force
- Royal Navy

United States

- United States Air Force
- United States Navy

General characteristics

Harpoon Block II test firing from USS *Thorn*.

- Primary function: Air-, surface-, or submarine-launched anti-surface (anti-ship) missile
- Contractor: The McDonnell Douglas Astronautic Company - East
- Power plant: Teledyne Teledyne J402 turbojet, 660 lb (300 kg)-force (2.9 kN) thrust, and a solid-propellant booster for surface and submarine launches
- Length:
  - Air launched: 3.8 metres (12 ft) 7 in)
  - Surface and submarine launched: 4.6 metres (15 ft)
- Weight:
  - Air launched: 519 kilograms (1140 lb)
  - Submarine or ship launched from box or canister launcher: 628 kilograms (1380 lb)
- Diameter: 340 millimetres (13 in)
- Wing span: 914 millimetres (36.0 in)
- Maximum altitude: 910 metres (2990 ft) with booster fins and wings
- Range: Over-the-horizon (approx 50 nautical miles)
  - AGM-84D (Block 1C): 220 km (120 nmi)
  - RGM/UGM-84D (Block 1C): 140 km (75 nmi)
  - AGM-84E (Block 1E) : 93 km (50 nmi)
  - AGM-84F (Block 1D): : 315 km (170 nmi)
  - RGM-84F (Block 1D): 278 km (150 nmi).
  - RGM/AGM-84L (Block 2): 278 km (150 nmi)
  - AGM-84H/K (Block 1G / Block 1J): 280 km (150 nmi)
- Speed: High subsonic, around 850 km/h (460 knots, 240 m/s, or 530 mph)

- Guidance: Sea-skimming cruise monitored by radar altimeter, active radar terminal homing
- Warhead: 221 kilograms (490 lb), penetration high-explosive blast
- Unit cost: US$1,200,000
- Date deployed:
  - Ship launched (RGM-84A): 1977
  - Air launched (AGM-84A): 1979
  - Submarine launched (UGM-84A): 1981
  - SLAM (AGM-84E): 1990
  - SLAM-ER (AGM-84H): 1998 (delivery); 2000 (initial operational capability (IOC))
  - SLAM-ER ATA (AGM-84K): 2002 (IOC)

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[2] Global Security Harpoon article

[3] "Military pacts on hold but India, US continue with exercises, arms deals" (http://timesofindia.indiatimes.com/india/Military-pacts-on-hold-but-India-US-continue-with-exercises-arms-deals/articleshow/6601777.cms). *The Times Of India*. September 22, 2010. .

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[15] http://thenews.jang.com.pk/updates.asp?id=87764

External links

- Official Harpoon information (http://www.boeing.com/defense-space/missiles/harpoon/index.htm) – Boeing website
- Detailed information of all Harpoon versions and upgrades (http://www.astronautix.com/lvs/harpoon.htm) – From Encyclopedia Astronautica
- AGM-84 variants (http://www.designation-systems.net/dusrm/m-84.html)
- McDonnell-Douglas AGM-84A Harpoon and AGM-84E SLAM (http://www.ausairpower.net/TE-Harpoon.html)
- FAS Harpoon article (http://www.fas.org/man/dod-101/sys/smart/agm-84.htm)
- Global Security Harpoon article (http://www.globalsecurity.org/military/systems/munitions/agm-84.htm)
- Boeing Harpoon Block III Press Release (http://www.boeing.com/news/releases/2008/q1/080131a_nr.html)

- Boeing Harpoon Block II Backgrounder (http://www.boeing.com/defense-space/missiles/harpoon/docs/HarpoonBlockIIBackgrounder.pdf)
- Royal Netherlands Navy launches Harpoons from new frigate HMS De Ruyter (Defense-Aerospace) (http://www.defense-aerospace.com/cgi-bin/client/modele.pl?prod=100076&session=dae.43173607.1227915838.b123k38AAAEAAA87SX0AAAAG&modele=release&prod=100076)

Electronics and Countermeasures

AN/SPS-49

AN/SPS-49

AN/SPS-49 on USS *Abraham Lincoln* (CVN-72)	
Country of origin	United States
Introduced	1975
Number built	200+
Type	2D Air-search
Frequency	L band 851–942 MHz
Range	3 nmi (5.6 km) to 256 nmi (474 km) (AN/SPS-49A(V)1)
Altitude	up to 150,000 ft (45,720 m)
Diameter	24 ft (7.3 m) × 14 ft 3 in (7.3 m × 4.3 m)
Azimuth	0 to 360°
Precision	1/16 nmi range 0.5 deg azimuth (SPS-49A(V)1)
Power	360 kW peak, 13 kW average (AN/SPS-49A(V)1)

The **AN/SPS-49** is a United States Navy two-dimensional, long range air search radar built by Raytheon that can provide contact bearing and range. It is a primary air-search radar for numerous ships in the U.S. fleet and in Spain, Poland, Taiwan aboard *Oliver Hazard Perry*-class frigates, Canada on its *Halifax*-class frigates, New Zealand on it's *Anzac*-class frigates and Australia on it's *Adelaide*-class frigates and *Anzac*-class frigates . It also serves in a complementary role aboard Aegis cruisers with the AN/SPY-1.

Operation

First tested in 1965 aboard USS *Gyatt* (DD-712) and introduced in 1975, the AN/SPS-49 is operates in the 851–942 MHz, or L-, band and has a range of 256 nautical miles (474 km). The orange-peel parabolic shape of the antenna creates a narrow 3.3°-beam to reduce the probability of detection or jamming. It can rotate at 6 rpm in long range mode or 12 rpm in short-range mode.[1] Default is at 12 rpm for the AN/SPS-49A(V)1, to provide more frequent scans against incoming missiles. The SPS-49A(V)1 can detect out to its full range at either 6 or 12 rpm. The antenna is stabilised to compensate for ships pitch and roll, to a maximum of +/-15° for both pitch and roll in 12 rpm mode, and +/-23.5° for both pitch and roll in 6 rpm mode. The output stage of the transmitter in all variants uses a two-cavity klystron amplifier.

Variants

As of 2010, there are eleven configurations of the AN/SPS-49(V).

- AN/SPS-49(V)1 - Baseline radar (Various CVN, LHA, LSD and other ships)
- AN/SPS-49(V)2 - (V)1 radar without the coherent side lobe cancellation feature (*Oliver Hazard Perry*-class frigates)
- AN/SPS-49(V)3 - (V)1 radar with the radar video processor (RVP) interface (FC-1) (USS *Long Beach* (CGN-9))
- AN/SPS-49(V)4 - (V)2 with the RVP interface (*Oliver Hazard Perry*-class frigates)
- AN/SPS-49(V)5 - (V)1 with automatic target detection (ATD) (New Threat Upgrade (NTU) ships)
- AN/SPS-49(V)6 - (V)3 system with double shielded cables and a modified cooling system (USS *Ticonderoga* (CG-47))
- AN/SPS-49(V)7 - (V)5 system with a (V)6 cooling system (Aegis combat system)
- AN/SPS-49(V)8 - (V)5 system enhanced to include the AEGIS Tracker modification kit (Aegis combat system)
- AN/SPS-49(V)8 ANZ - (V)8 system modified to interface with the CelsiusTech 9LV-453 combat system (*Anzac*-class frigates)
- AN/SPS-49(V)9 - (V)5 with medium PRF upgrade (MPU)
- AN/SPS-49A(V)1 - Developed in the mid 1990s. Added radial speed determination on each target, each scan. Improved clutter rejection

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[1] GlobalSecurity AN/SPS-49 (http://www.globalsecurity.org/military/systems/ship/systems/an-sps-49.htm)

External links

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AN/SPS-55

AN/SPS-55

AN/SPS-55 antenna on USS Samuel B. Roberts (FFG-58)

Country of origin	United States
Introduced	1971
Type	Surface-search
Frequency	I band (9.05 to 10.0 GHz)
Range	greater than 50 nautical miles (92.6 km)[1]
Azimuth	1.5°
Elevation	-10° to +10°, centered on the horizon
Precision	
Power	130-160 kW peak power

The **AN/SPS-55** is a solid state surface search and navigation radar. It was developed by Cardion Electronics for the U.S. Navy under a contract awarded in 1971. It was originally developed for a class of ships known as Patrol Frigates, but it was also installed on numerous Cruisers, Destroyers and Minesweepers. It is an I band radar and it's antenna consists of two waveguide slotted arrays mounted back-to-back. One array provides linear polarization and the other provides circular polarization. Polarization is user selectable and the circular polarized array is more effective in reducing returns from precipitation.[2]

Features

- Magnetron transmitter
- Low noise RF receiver
- Sensitivity time control
- Fast time constant filtering
- Sector radiate

The effective range of the radar is from 50 feet to beyond 50 miles. It is primarily used to detect other ships, coastlines and navigation hazards.

Platforms

- Ticonderoga class cruisers
- Spruance class destroyers
- Oliver Hazard Perry class frigates
- Avenger class countermeasure ship

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AN/SLQ-25 Nixie

SLQ-25 Nixie aboard USS *Iowa* (BB-61)

The **AN/SLQ-25 Nixie** and its variants are towed torpedo decoys used on US and allied warships. It consists of a towed decoy device and a shipboard signal generator. The decoy emits signals to draw a torpedo away from its intended target.

The Nixie attempts to defeat a torpedo's passive sonar by emitting simulated ship noise, such as propeller and engine noise, which is more attractive than the ship to the torpedo's sensors.

The more modern AN/SLQ-25B includes equipment of the AN/SLQ-25A (refreshed variant of the AN/SLQ-25 to include fiber optic towed cable and COTS equipment) and incorporates a towed array sensor to detect submarines and incoming torpedoes. The AN/SLQ-25B also incorporates additional active sonar decoys by receiving, amplifying, and returning "pings" from the torpedo, presenting a larger false target to the torpedo.

Typically, larger ships may have two Nixie systems mounted on the rear of the ship to allow operation singularly or in pairs while smaller ships may have only one system.

Under a joint UK/ US Memorandum of Understanding, the UK MoD and the US DoD are furthering torpedo survivability systems. The US is currently working on an Active Source programme called the DCL Technology Demonstrator programme and the UK has developed and entered into service the S2170 Surface Ship Torpedo Defence system.

External links

- http://www.fas.org/man/dod-101/sys/ship/weaps/an-slq-25.htm
- http://www.janes.com/extracts/extract/juws/juws0325.html

AN/SLQ-32 Electronic Warfare Suite

The **AN/SLQ-32** is a shipboard electronic warfare suite built by the Raytheon Company of Goleta, California. It is currently the primary electronic warfare system in use by U.S. Navy ships (as of 2007).

Variants

Referred to by it operators as the "slick-32". The SLQ-32 was originally conceived in the 1970s to augment the AN/WLR-1, which had been in service since the early 1960s. It was later determined to save costs to replace the various WLR-1 series suites with the SLQ-32 as a stand alone system. As originally designed, the SLQ-32 was produced in three variants, the (V)1, (V)2 and (V)3. Later in its service life, two additional versions were built, the (V)4 and (V)5.

- **SLQ-32(V)1** – A simple threat warning receiver, it was capable of receiving high-band radar signals of the type commonly carried on missiles and aircraft. The (V)1 was installed on auxiliary ships and small combatants such as frigates. This variant of the system is being phased out as current ships equipped become decommissioned.
- **SLQ-32(V)2** – Initially the most common variant, the (V)2 added the ability to receive surveillance and targeting radars. This provided a passive targeting capability for Harpoon missile-equipped ships. The (V)2 was installed on frigates, destroyers, and 270-foot (82 m) Coast Guard Cutters.
- **SLQ-32(V)3** – Expanding on the (V)2's capabilities, the (V)3 added active radar-jamming capability. The (V)3 was installed on various combatants such as cruisers, battleships, large amphibious ships and high-value replenishment vessels.
- **SLQ-32(V)4** – Designed for installation on aircraft carriers, the (V)4 consisted of two (V)3 systems, one for each side of the ship, tied to a common computer and display console. Additional line replaceable units and software were added to support the wide separation of the two antenna/electronics enclosures.
- **SLQ-32(V)5** – The (V)5 was built as a response to the Stark incident in 1987. The (V)5 incorporated a compact version of the (V)3 system intended to give active jamming capability to the *Perry* class FFG's, which were too small to carry a full (V)3.

Sidekick jamming antenna on USS Ford (FFG-54) part of (V)5.

All versions of the SLQ-32, with the exception of the (V)4, are interfaced with the MK36 Decoy Launching System, able to launch chaff and infrared decoys under the control of the SLQ-32. The number and arrangement of MK36 launchers installed depends on the size of the ship, ranging from two launchers on a small combatant to as many as ten on an aircraft carrier. A growing number of systems are being upgraded to incorporate the multi-national MK-53 Nulka system.

The original modular design was intended to allow upgrades of the system from one variant to the next by simply installing additional equipment as required. Starting in the early 1990s, a program was begun to upgrade all SLQ-32s in the U.S. fleet. Most (V)1 systems were upgraded to (V)2, and most (V)2 systems were upgraded to (V)3. This was normally carried out during a major ship overhaul.

Contract

The initial procurement process was built around a “design to price” concept in which the final delivery cost per system was fixed in the contract. The SLQ-32 was designed to support the protection of ships against anti-ship missiles in an open sea environment. After initial deployment of the system, naval roles began to change requiring ships to operate much closer to shore in denser signal environments. This change in roles required changes to the SLQ-32 systems which were added over time. With experience gained working with the SLQ-32, coupled with improvements to the hardware and software, technicians and operators gradually overcame the initial problems. The SLQ-32 is now the mainstay of surface electronic warfare in the U.S. Navy and U.S. Coast Guard's WMEC 270-foot (82 m) Class Ships.

Future

In 1996, a program called the *Advanced Integrated Electronic Warfare System* (AIEWS) was begun to develop a replacement for the SLQ-32. Designated the AN/SLY-2, AIEWS reached the prototype stage by 1999, but funding was withdrawn in April 2002 due to ballooning costs and constant delays in the projects development. It has since been replaced with General Dynamics' *Surface Electronic Warfare Improvement Program* (SEWIP), which will build on the existing SLQ-32 hardware and technology in an evolutionary fashion.

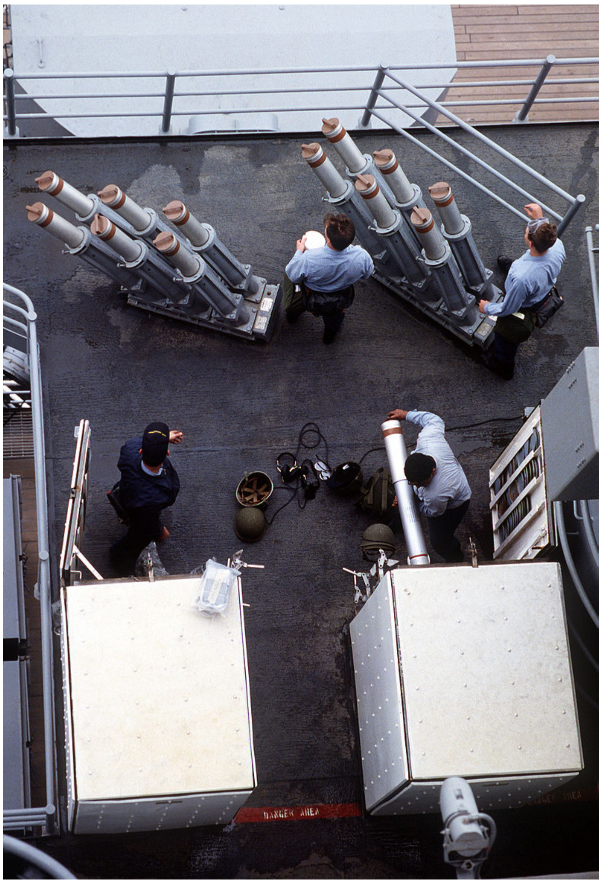
External links

- Federation of American Scientists: AN/SLQ-32 Electronic Warfare (EW) system [1]
- Raytheon Product Description for the AN/SLQ-32 [2]
- AN/SLQ-32 in the *Warfighters Encyclopedia* [3]
- AN/SLQ-32(V)5 Data Sheet [4]
- EXHIBIT R-2, RDT&E Budget Item Justification [5]
- Surface Electronic Warfare Improvement Program (SEWIP) [6]

Mark 36 SRBOC

The BAE Systems **Mark 36 Super Rapid Blooming Offboard Chaff** (abbreviated as **SRBOC** or "Super-arboc") is a short-range mortar that launches chaff or infrared decoys from naval vessels to foil anti-ship missiles. Each launcher has four tubes set at a 45-degree angle, and two tubes set at a 60 degree angle, providing an effective spread of decoys and countermeasures to defeat radio frequency emitting missiles. The SRBOC can also be fitted with the TORCH infrared "flare" decoy system. A typical ship's load is 20 to 35 rounds per launcher.

As of 2010, the Mk. 36 SRBOC is used by 19 navies around the world. It is similar to the NATO Sea Gnat system.



Two Mark 36 Mod 7 Super Rapid Bloom Off-board Chaff (SRBOC) system launchers aboard the battleship USS Wisconsin (BB-64) during Operation Desert Storm.

External links

- Federation of American Scientists page [1]
- SRBOC Factsheet [2]

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